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AN ANALYSIS OF THE ABILITY OF COMMERCIAL
WARGAMES TO FULFILL THE EDUCATION
REQUIREMENTS OF THE AIR FORCE
WARGAMING CENTER

THESIS

Scott Goehring
Captain, USAF

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An Analysis of the Ability of Commercial Wargames to Fulfill the
Education Requirements of the Air Force Wargaming Center

THESIS

Presented to the Faculty of the School of Engineering
of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Operations Research

Scott Goehring, B.S., M.B.A.

Captain, USAF

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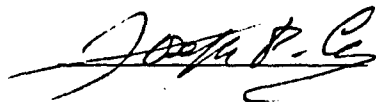
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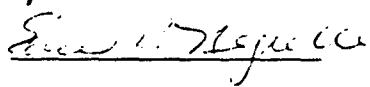
THESIS TITLE: An Analysis of the Ability of Commercial Wargames to Fulfill
the Education Requirements of the Air Force Wargaming Center

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COMMITTEE:	NAME/DEPARTMENT	SIGNATURE
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Co-Advisor	Dr. Joseph P. Cain/ENS	
------------	------------------------	---

Co-Advisor	Mr. Michael W. Garrambone/ENS	
------------	-------------------------------	---

Co-Advisor	Maj Edward P. Negrelli/ENS	
------------	----------------------------	---

Preface

This study examines existing commercial wargames to determine their capabilities of fulfilling the education requirements of the Air Force Wargaming Center. This topic was recommended and sponsored by the Air Force Wargaming Center, although the results of this study should be useful to other Wargaming Centers or other military wargaming organizations who are interested in the possible application of commercial wargames.

I would like to acknowledge several people for their contributions to this thesis. My three co-sponsors were: Major Ed Negrelli who taught me most of my combat modeling expertise. Dr. Joseph Cain patiently advised me in this endeavor and provided an enthusiasm that helped motivate me, and Major (Ret) Mike Garrambone added numerous insightful contributions from his extensive modeling background. I thank my parents for their confidence and encouragement, and my wife Deborah for having the patience and understanding to endure the thesis writing process. Finally I wish to thank my son Zachary for providing a joyful distraction that allowed me to keep everything in the proper perspective.

Scott Goehring

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Abstract

It has been the contention of some that current commercial wargames could possibly fulfill the education requirements addressed by the Air Force Wargaming Center. The Wargaming Center, lacking the opportunity to conduct a thorough, in-house analysis of these commercial wargames, requested an independent evaluation be performed. This thesis identifies potential commercial wargames and provides an analysis of those wargames to determine their ability to educate senior military officers in the application of aerospace power. In addition, this thesis establishes a set of Measures of Effectiveness (MOEs) against which future wargames can be easily evaluated. The MOEs were developed from the roles and missions of aerospace power as defined in Air Force Manual 1-1, Volume II. Thousands of commercial wargames have been created in the past 35 years, and hundreds of these address airpower in some form. Nearly all were easily eliminated due to the abstracted manner in which airpower was addressed, or the scope of the individual wargame. Wargames which focus only on small numbers of aircraft are inappropriate for teaching the employment of aerospace power because they focus on individual aircraft tactics and not on the overall battle. Four wargames, the board wargame *Gulf Strike*, and the computer wargames *Air Force Commander*, *Conflict: Korea*, and *Conflict: Middle East* were the only models which actually survived the screening process and reached the evaluation stage. While each wargame had numerous innovative ways of simulating airpower, none were found adequate to satisfy the education requirements of the Air Force Wargaming Center. In addition, none could be easily modified to correct the identified deficiencies.

An Analysis of the Ability of Commercial Wargames to Fulfill the Education Requirements of the Air Force Wargaming Center

I. Introduction

1.1 Background

The ever increasing cost, complexity and lethality of modern weapon systems, coupled with the decreasing defense budget has U.S. military leaders searching for new ways to train their troops for combat. In recent years, the Air Force has realized that wargames and the art of wargaming is one comparatively cost-effective way to provide valuable training and education in force coordination and employment. The Air Force uses wargames for analysis, education, and training. Organizations like the USAF Studies and Analysis agency at the Pentagon, and many other services headquarters level agencies, are primarily concerned with the analysis aspects of wargames. Training is the main focus of places like the Warrior Preparation Center, Red Flag, and Blue Flag, while education is the main focus of the Air Force Wargaming Center. The primary reasons for establishing the Air Force Wargaming Center in 1986 at Maxwell AFB, Alabama was to educate military personnel in the employment of aerospace power. Here, senior and junior officers can use wargames to practice the art of decision making in modern warfare. The Center personnel develop, test, and then conduct the *play* of wargames designed to fulfill the specific education requirements of individual customer organizations. These organizations include the Air Force's Air War College, Air Command and Staff College, and Squadron Officers School, the Canadian Armed Forces Combined Staff College, the Royal Air Force Staff College, and the Joint Flag Officer Warfighting Course.

The Department of Defense (DOD) *Dictionary of Military and Associated Terms* defines a war game as "A simulation, by whatever means, of a military operation involving two or more opposing forces, using rules, data and procedures designed to depict an actual or assumed real life situation" [4:393]. Note that the spelling of war game as two words is the manner which the Army and Navy prefer while the Air Force and civilian community use the single word wargame. This paper will use the Air Force and civilian spelling unless specifically quoting an Army or Navy source. The military has created hundreds of professional wargames for the purpose of simulating combat situations for analysis, education, and training. Almost all of these games are computer based and span the gamut from high resolution models (one-on-one, few-on-few) to aggregated systems of battalions, divisions, or corps.

A large commercial wargaming industry also exists. Mr. James Dunnigan, author of over 100 commercial wargames and several books states:

A wargame is a combination of "game," history and science. It is a paper time-machine. It usually combines a map, playing pieces representing historical personages or military units and a set of rules telling you what you can or cannot do with them. The object of any wargame (historical or otherwise) is to enable the player to recreate a specific event and, more importantly, to be able to explore what might have been if the player decides to do things differently [8:11].

There are over one dozen large companies (those that produce more than ten individual titles) and countless smaller companies throughout the world that develop, produce, and sell commercial wargames. A few of these companies are large enough to be organized and run like any typical small business, where profit is the primary motive for existence. The majority of the companies are small enterprises that exist primarily because of their owners' "love" of the hobby. When the owner or owners of these companies publish their first wargame, they usually hope that the profits from their endeavor will be sufficient to allow them to make a living, but unfortunately many of them soon discover that without national exposure, the market is simply too small. As a result, many of these companies only last a short time before they

run out of financing or sellout to a larger company. The games these companies produce address literally every past conflict and many hypothetical future ones on every scale imaginable.

Cap. Jude Fernan (GST 93M) established a precedent for thesis work at AFIT on wargaming with his *Gettysburg: An Analysis of the Training Value of Commercial Models*[13:]. He outlined the many reasons why wargaming is used for training by the military, with low cost and short preparation time being two of the chief benefits. He then goes on to make his case why commercial wargames have definite training value to the Army. Dunnigan also believes strongly that commercial wargames have a great deal to offer the military. He states "Commercial modeling companies . . . do a somewhat better job of modeling warfare for several reasons. Their overwhelming attention and emphasis to the historical event upon which the game is based is foremost among these reasons"[8:142].

Men like Dunnigan and Mr. Frank Chadwick (President of Game Designers Workshop and author of dozens of commercial wargames) have been invited to address various military audiences on numerous occasions on the use of wargames and combat modeling. These men are among the advocates within the commercial wargaming community who believe that commercial wargame companies could perform the role of places like the Air Force Wargaming Center at substantially lower cost. The argument they make is that buying a dozen commercial wargames "off the shelf" at thirty to forty dollars a copy is much cheaper than paying personnel to spend a whole year developing wargames for the military. Some advocates feel there are commercial wargames on the market that already address the very same issues as many of the Air Force Wargaming Center's wargames. If they are correct, then it would appear logical to purchase and use commercial wargames.

An area of criticism of the Air Force Wargaming Center is the tedious nature of their simulations, most of which extensively address issues like supply and command and control. These are areas that most commercial wargames ignore completely,

or address in some aggregated, simplistic manner. This is understandable, since a commercial wargame has to be exciting to play, or it will not sell. When someone buys a commercial wargame, that person wants to move tanks, fighters, infantry, and artillery around: not calculate pallet loads of supply materials for a fleet of C-141 transport aircraft! While this theory works very well in the commercial sector, today's officer must understand all of the factors which determine if a force is to be successful on the battlefield. The largest air force in the world is useless if there are no bombs or fuel available for the aircraft.

With an already active schedule, the Air Force Wargaming Center itself has little time to review commercial wargames for their potential use as education devices and has not assessed the usefulness of the great majority of these commercial wargames for fulfilling the individual education requirements of their customer organizations.

1.2 Specific Objective

The purpose of this research was to analyze current commercial wargames, selecting those which could potentially fulfill the education requirements of the Air Force Wargaming Center. Once selected, each wargame was analyzed against a set of Measures of Effectiveness (MOEs) to determine how completely it met the education requirements of the Wargaming Center. Finally, each wargame found deficient was evaluated to determine what modifications could make it capable of fulfilling the Wargaming Center's education requirements.

To achieve these objectives, the following actions were taken:

- Visit the Air Force Wargaming Center and interview members of the staff
- Review current modeling techniques
- Research existing wargames and select candidate wargames
- Develop Measures of Effectiveness

- Analyze selected wargames
- Determine modifications which would allow the use of unsuitable games

1.3 Methodology

The starting point of this thesis was a visit to the Air Force Wargaming Center at Maxwell AFB, Alabama. Several members of the staff were interviewed to gain background information on their mission. Documentation of many of their wargames, as well as points of contact at client organizations were also obtained.

Next, I began a study of current literature on the topic of wargaming. Books by Perla, Dunnigan, and the staff of Strategy & Tactics magazine, as well as AFIT courses in *Land Combat Modeling* provided an insight into the history of wargaming and helped develop an understanding of the usefulness and limitations associated with combat models. This portion of the research was mandatory to provide the foundation for an honest evaluation of the potential usefulness of any commercial wargame.

The next step was to select the wargames for evaluation. As mentioned earlier, thousands of commercial wargames exist on every scale imaginable, and more are being produced all the time. TSR, one of the largest commercial wargame companies, planned to introduce 140 new titles during 1992 alone. In order to make the selection task manageable, it was necessary to limit the games under consideration. A detailed account of this process appears in Section 1.4.

Once the candidate wargames had been obtained, it was necessary to establish MOEs in order to evaluate them. The MOEs are somewhat subjective in nature and are more clearly defined in chapter three. They were developed primarily from the Aerospace Roles and Missions as defined in Air Force Manual 1-1, Volumes I[5:6-7] and II[6:103-109].

The task of analyzing the wargames was the most time consuming. Each wargame was played several times to gain an appreciation for the capabilities it possessed. This task was made more manageable due to my rather extensive background in board wargaming, which has been my principle hobby for the past sixteen years. This familiarity with virtually every type of commercial wargame made it much easier to digest and comprehend each rulebook and provided a useful benchmark for comparing the chosen wargames.

If a wargame was found lacking, the analysis did not end. The final task was to determine if the wargame could be modified to fulfill the Air Force Wargaming Center's education requirements. Obviously, with enough modifications, any wargame can be corrected to meet these education requirements, so once again a subjective evaluation had to determine whether the required modifications were within reason. Certainly, a complete rewrite of major portions of a game would be considered unreasonable.

1.4 Constraints

There was no way to examine every single commercial wargame in existence for applicability, so several assumptions were made to narrow the scope. Only games that are currently in production were considered. This was a logical starting point because if a game was found suitable, then it had to be readily accessible at a reasonable price. Out of print games add a number of complicating factors to the acquisition process that could potentially increase the cost and acquisition time to an unacceptable level.

The scale of the game and the time-frame in which it is set were also considerations. Tactical level (one-on-one, few-on few) wargames were excluded because the Wargaming Center is not tasked to train pilots in aerial combat tactics. It is simply not their mission. This criteria served to eliminate a great many games since they focus exclusively on single plane duals. Likewise, pre World War II era games, although

many included air components, were excluded from consideration since modern-day tactics and weapon capabilities are so significantly different. Games about World War II and Korea were evaluated to see if they contained air components. Those that did were then more closely examined to see if they utilized tactics which were still applicable today.

Finally, it was desirable that the game be suitable for play by groups of individuals. The Wargaming Center primarily focuses on educating commanders and command staffs in the art of modern warfare with particular emphasis on the proper employment of airpower. This final consideration proved to be quite a barrier because the great majority of commercial wargames are designed for two person or solitaire play. Most games would have to be modified in some manner to allow their use as an educational tool for a command staff. For additional details on the selection procedure, see chapter 4.

II. Literature Review

2.1 Introduction

The literature review for this thesis was a bit unorthodox. It included not only an effort to become familiar with the current issues in the arena of combat simulations, but also attempted to cover the entire spectrum of the existing commercial wargame market. Additional research was required to gain expertise on the capabilities of certain weapon systems as well as an historical background on battles simulated by chosen commercial wargames. The following paragraphs will acquaint the reader with the existing literature which aided in the completion of this study.

This research was not attempting to prove or disprove the validity of wargames as an educational device. The ever expanding number of wargames throughout all branches of the military serves as testimony to their acceptance for training, education, and analysis purposes. For that reason, a discussion of the various wargames developed and utilized by the military is not included. Therefore, this literature review began with an examination of some of the proponents for the use of commercial wargames.

2.2 Wargaming Advocates

One of the leading authorities on Wargaming in the United States Navy is Dr. Peter P. Perla. His book, *The Art of Wargaming*, is one of the more current writings dealing with this subject, not just from the commercial standpoint, but incorporating the history of wargaming in the United States Navy as well. Perla's book provides a valuable summary of the history of wargaming and provides especially detailed information on the evolution of wargaming and its uses within the Navy. The Navy has been using wargaming since the middle 1800s to aid in the training and education process. The Navy was certainly the first branch of the U.S. armed forces to make

extensive use of wargames, and has actually experimented with the use of commercial wargames.

During the early 1980s, one of the navy's principle independent operations research centers, as part of a project in support of navy wargaming research, used several commercial hobby board games to educate and train new analysts. The game *Flat Top* (published by The Avalon Hill Game Company) was used to educate these analysts about the origins of U.S. aircraft carrier tactical doctrine in World War II. The game *Sixth Fleet* (published by Victory Games, Inc.) brought them forward into the modern era at the same level of action (theater). Moving up to the realm of global maritime strategy, the game *Scapower and the State* (published by Simulations Canada) allowed them to explore broader issues[24:295].

Perla mentions another game used to acquaint the analysts with the problems of ground war and then concludes with the following sentence. "The use of these hobby games not only facilitated the orientation of these new analysts (whose backgrounds were in chemistry and industrial administration) to military problems, but also helped them in their subsequent analysis of navy wargames"[24:295].

So who are these wargamers? According to James Dunnigan, in his most recent book *The Complete Wargames Handbook, Revised Edition*, which was published in late 1992, "Wargaming is the hobby of the overeducated"[7:222]. Dunnigan devotes an entire chapter to assessing the types of people who play wargames and the time periods of history they prefer. His source for this information are the various questionnaires published by *Strategy & Tactics* magazine. According to Dunnigan, "Today, the majority of wargamers have been at it for over 10 years"[7:223]. Dunnigan includes a detailed account of the changing demographics of the wargaming community. He includes the following information on today's wargamers.

Many players are still students. Nearly all age 22 and under are. Taking the entire gamer population, about 20 percent are in the military (including Department of Defense and CIA civilians). Some 5 percent are officers in combat units, another 4 percent are NCOs and troops in combat units[7:232].

Dunnigan also states that 10 percent are in blue-collar occupations and a third are in professional occupations like lawyers, doctors, clergy and scientists. He concludes with the following:

By most definitions, wargamers are a select group, above average in education, income, and, especially, diligence. Wargames are not easy to master. Unique mental skills are required to deal with all that goes on in a wargame and make the game work. Even computer wargames are considered a cut above average in complexity compared to most other games. But what most distinguishes wargamers is their desire to explore the past and find out not only what has happened, but details of why and how it happened[7:233].

So why do people play wargames? The military uses them to provide training and education designed to enhance their ability to accomplish their primary objective, deterrence. Yet a growing commercial industry makes its living on the creation and sale of games which simulate war. The reactions I receive when I tell people that my favorite hobby is wargaming ranges from a blank stare because they have never heard of them, to bewildered amusement that a grown man would spend twenty or more hours a week pushing cardboard counters around a mapboard.

Fire & Movement (one of the premier commercial wargaming magazines) conducted a survey of its readers to see why they played wargames. The number one answer was "to simulate what they had read". Other answers included "I enjoy the intellectual challenge and competition"; "I am a student of history"; "I like the fellowship and social exchanges that gaming provides"[25:11]. Perla includes the following quote by H.G. Wells: ". . . wargamers seek information, understanding, and (be honest now!) glory"[24:3]. Dunnigan states "By far the most common reason for playing games is to experience history"[8:109]. I play wargames for all of the above reasons and because I believe that they teach me valuable lessons about warfare that could prove helpful if ever I find myself in a combat situation. It is important to remember that wargames alone can not possibly prepare anyone for combat, but

they can provide insight into the decision making process which may very well prove beneficial on the battlefield.

Dunnigan presents some basic guidelines for the design of commercial wargames in his latest book, *The Complete Wargames Handbook, Revised Edition*. He includes a recipe for designing games and some general hints on strategies to be used when playing. The book also provides an extensive coverage of the growing computer wargame industry.

Yet while annual sales of manual wargames amount to a few hundred thousand units (and dropping each year), computer wargames sell over half a million units a year (and are rapidly increasing). If you include the simulator-type games (aircraft, vehicle, and others), several million computer wargames are sold each year[7:171].

Dunnigan seems to be predicting the downfall of the board wargame industry as the personal computer revolution takes over. He just may be correct (more on this later).

Since the revised edition was only recently available, my initial research included the original version of *The Complete Wargames Handbook*. This book also included the basic guidelines for the design of commercial wargames, but since it was written in 1980, it contained much less information on what was then the infant stages of computer wargaming. The older book also includes a section which rates existing board wargames, but this portion was of limited value since it is outdated and many of the games reviewed are no longer available. Additionally, the state of the hobby has advanced significantly since 1980, and none of the games created since then could have been included.

In the early 1970s, Dunnigan was approached by a group of young officers at the Army Infantry School. They wanted him to design a game that the army could use for training soldiers. "It took a few years but eventually, with the help of a \$25,000 development contract from the Army, we produced a game, called Firefight"[8:87]. Dunnigan goes on to say that the army stopped using the game because it was "too

complicated". Dunnigan then summarizes that this is an example of how the military works. He cites favorable reviews that the game received, and additional expenses the Army incurred in rewriting and illustrating the rules.

It is true that for most training purposes, the game probably was too complicated and required too much work. It should have used a computer. I have given this advice to any number of military organizations when questioned about using wargames for training. Manual wargames require work, more work than a nongamer who does not have a requirement to use the games professionally might want to invest. The obvious solution is to use the old microcomputer[8:87].

This is an interesting comment and is quite true. When I demonstrate a board wargame to non-wargamers, it is often difficult to keep their attention, but when demonstrating a computer wargame, the interest level seems much greater. In addition, the pull down menus available in today's computer simulations makes them quite user friendly. The best part is not having to take time to look up combat effects, calculate combat odds, and then resolve each battle by rolling a die and looking up the result in another table. The computer does all that for you. The following example will illustrate the time involved in resolving combat in a board wargame. Assuming the players are very familiar with the wargame, they will probably have the majority of the combat results tables memorized. Many wargames utilize a simple combat results table based upon odds ratios of attacker-to-defender (see Fig 2.1). To resolve an individual combat, you must total up the attacking combat factors and the defending combat factors and then calculate the odds, usually rounding off in favor of the defender. Then you roll the dice and consult the combat results table to determine the outcome. Even for experienced gamers, this process can take five to ten seconds per battle. If your wargame requires one hundred combat resolutions in the course of the battle, that translates to 500 to 1000 seconds spent calculating combat and rolling the dice. Additional time will be required to retreat defeated units, advance victorious units, and remove eliminated units from the mapboard. As a general rule, the more complicated and realistic your wargame, the more types

	1-4	1-3	COMBAT ODDS		2-1	3-1	4-1
			1-2	1-1			
1	A Elim	A Elim	A Elim	A Back 2	A Back 2	Engaged	D Back 2
2	A Elim	A Elim	A Back 2	A Back 2	Engaged	D Back 2	D Back 2
Dice Roll	3	A Elim	A Back 2	A Back 2	Engaged	Engaged	D Back 2
	4	A Back 2	A Back 2	A Back 2	Engaged	D Back 2	D Back 2
	5	A Back 2	A Back 2	Engaged	D Back 2	D Back 2	D Elim
	6	A Back 2	Engaged	D Back 2	D Back 2	D Elim	D Elim

Figure 2.1. Sample Combat Results Table

of combat resolution tables exist and the more combat dice rolls occur in the game. Dunnigan is right when he says that "Manual wargames require work".

Wargame Design was written by the staff of *Strategy & Tactics* magazine in 1976. They were part of Simulations Publications, Inc. (SPI), the largest commercial wargaming company in the world at that time. The book addresses issues like the history of wargaming, game design and development, graphics, research, the business aspects of the commercial wargame market, and a wargame directory. SPI is no longer in business but many of their titles live on with other companies like Avalon Hill and TSR. Although the book is somewhat dated, the chapter on business aspects offers details on the problems and costs of wargame publishing. This chapter serves to illustrate how these cost concerns can dictate the contents of a commercial board wargame which one might buy off the shelf.

2.3 The Search For Usable Models

The search for potential usable wargames began with the collection of catalogs from various computer stores and companies. By far the most useful catalog was from *Wargames West*, a large wargame store in Albuquerque, New Mexico which specializes in wargames, adventure games, and miniatures. *Wargames West* has a

retail store in Albuquerque, but they rely on an extensive mail-order business for most of their sales. Their catalog has listings for different companies and they carry virtually the entire line of games for each company. The catalog provides not only a list of each companies current wargames, but normally includes a small paragraph describing the focus and scale of each game, as well as a listing of expected future releases. If a wargame sounded promising based upon this description, then I was able to pursue additional information about the game from people who were more familiar with it.

The Best of Board Wargaming provides another version of the history of wargaming and the various types of wargames available. The author then provides a review of 134 wargames. He begins with standard information including the manufacturer, level, theater, period, number of players and duration. Then he includes a narrative discussion of some of the features contained in the game which he either liked or didn't like. Sometimes he includes a discussion of strategies required to play the game successfully. He concludes with the following rating assessment:

- Excitement Level (0=boring, 100=thrilling)
- Rules Clarity (0=incomprehensible, 100=crystal clear)
- Complexity (0=trivial, 100=insanely complex)
- Realism (0=totally artificial, 100=utterly convincing)
- Solitaire Playability (0=not at all, 90=no problem, over 90=especially good)[23:55]

The Complete Book of Wargames by the editors of Consumers Guide also provides background information on the wargaming hobby. The main focus is on rating different wargames, to include the following areas: publisher, subject, playing time, scale, size, balance, key features, and comments. It then summarizes each game in a brief evaluation which includes: presentation, rules, playability, realism(all rated poor to excellent), complexity (on a scale from 1 to 10), and an overall evaluation (again, poor to excellent)[10:73-75].

The most important thing to remember about both of these books is that the rating systems are quite subjective in nature. Additionally, both books were completed in 1980 and as such were compared against games which existed at that time. It is quite possible that many of these ratings would be different today in light of advancements that have occurred in the hobby. The books were helpful in identifying some wargames to eliminate.

The search also included a visit to the various computer stores and hobby stores within the Dayton area. Conversations with the owners of these stores provided valuable information on current titles and expected future releases. It also provided some additional information on some of the potential wargames discovered in the various catalogs. This information came in the form of being able to read the game descriptions printed on the game boxes, which are normally more extensive than the catalog listings and usually includes pictures of some of the counters and portions of the mapboard. The major problem encountered was the lack of uniform definitions of tactical and operational level games. Tactical level games are those which address small unit actions such as companies, or flights of aircraft, in a relatively small area. Tactical level games would focus on individual tactics. Operational level games feature larger formations of troops and aircraft over a larger battlefield, like the Fulda Gap or the Battle of the Bulge. Operational level would include at least a few brigades, up to several divisions or possibly even corps. The Korean war is a good example of a theater level battle, involving the entire assets of the two principle countries, North and South Korea, and significant portions of the assets of the U.S. and China (plus the UN contingent). Strategic level games are the largest, focusing on global scale conflicts like World War II. One company listed a game as operational level, but all the published scenarios turned out to be company level battles within a fifty square mile area. This was an important discovery which allowed me to eliminate several titles which were inappropriate for the scope of this study.

Attendance at Avaloncon II, a four day wargaming tournament sponsored by the Avalon Hill Game Company in Harrisburg, Pennsylvania provided an opportunity to view a number of potential titles and speak to wargamers who had actually played the games. Approximately 1000 wargamers gathered from throughout the United States and Canada, and a few even came from Europe to compete. Only Avalon Hill and Victory Games, Inc. were represented at the convention. Both of these companies are owned by the same parent organization, Monarch Avalon. Avaloncon is for their games and customers only. The convention did confirm a number of wargames were inappropriate for this study. A detailed discussion of why these wargames were inappropriate can be found in chapter four.

A phone conversation on 8 September 1992 with Mr. James Dunnigan provided additional points of contact in my search for potential wargames. The most valuable contact was Mr. Lou Zocchi, President of Gamescience Corporation and owner of Zocchi Distributors, a wargame store in Gulfport, Mississippi. He is the author of the Avalon Hill game *Luftwaffe*, as well as the Gamescience Corporation games *Battle of Britain*, *Flying Tigers*, *Basic Fighter Combat* and *Advanced Fighter Combat*. In an extensive phone conversation on 8 September, he provided a list of all the titles he was familiar with which covered operational level battles including air components. He then put me in contact with Mr. Matt Caffrey.

Mr. Caffrey, a major in the U.S. Air Force Reserve, is a Research Associate for the School of Advanced Airpower Studies at Maxwell AFB, Alabama. He was co-author of the *Gulf War Fact Book* with Mr. Frank Chadwick, and has assisted with the development of the Avalon Hill games *Flight Leader* and *Tac Air*. He was the Air Force point of contact for Project Warrior wargaming from 1982 to 1987. Project Warrior was an Air Force program designed to encourage its members to adopt more of a war-fighting attitude and to pursue a career long effort to prepare themselves for combat operations. Mr. Caffrey was able to provide me with his list of all known computer and board wargames which contained an air component.

In addition, his data base included an assessment of several of those games which proved quite helpful in my search for usable wargames.

After reviewing all of the above material, I felt very confident that the wargames selected for this study represented just about everything currently "in print". As I mentioned earlier, with the myriad of small companies around the world, it is extremely possible that I may have overlooked a wargame or two, but I know of no way that this could have been avoided. Additionally, any wargames published beginning in January 1993 could not be included due to the time constraints upon the study.

III. Approach to the Problem

3.1 Introduction

This research effort was considerably more complex than it may appear. It was much more involved than just simply visiting a few wargame stores and choosing commercial wargames. The effort required a thorough understanding of the Air Force Wargaming Center's mission and education objectives. Unfortunately, no generic list of objectives existed which could easily be incorporated into this study as the Measures of Effectiveness (MOEs). This lack of a standard set of clearly defined education objectives necessitated a search of existing Air Force Doctrine on the employment of airpower which eventually lead to the MOEs chosen for this study. Once the MOEs had been developed, it was possible to select commercial wargames which might potentially cover these areas. Again, this search for potential wargames was more difficult than one might expect because no all-inclusive document exists. An additional requirement was the development of combat modeling expertise to understand the techniques and limitations of wargames. Armed with this knowledge, the process of evaluating each potential commercial wargame could begin. Following each evaluation, the final task was an assessment of potential modifications which could correct the deficiencies of unsuitable wargames, thus allowing their use by the Air Force Wargaming Center.

3.2 Air Force Wargaming Center Education Objectives

Prior to my selection of this thesis topic, I had not even heard of the Air Force Wargaming Center and so had no idea what they did. A visit to their facility at Maxwell AFB, Alabama provided the necessary background. The Wargaming Center is primarily responsible for enhancing the understanding of the employment of aerospace power of senior level military leaders. As such, they do not focus on individual aircraft tactics, such as the best maneuver to make if being attacked by an

enemy fighter, or the best approach altitude for an airfield strike, etc. They are more concerned with the theater level application of air assets. Factors of concern include the types and numbers of aircraft available, sortie rates, supply issues, command and control, ground support, air supremacy, etc.

One unique feature of the Air Force Wargaming Center is that they custom design games to meet the individual needs of their customer organizations. These include the Air Force's Air War College, Air Command and Staff College, and Squadron Officers School, as well as the Canadian Armed Forces Combined Staff College, the Royal Air Force Staff College, and the Joint Flag Officer Warfighting Course, just to name a few. As such, many of their wargames have education objectives unique to that wargame alone. It is fair to say that no two Wargaming Center wargames have the exact same education objectives. As an example, the objectives for *Global Reach 2000*, a wargame designed to educate attendees about the merits and utility of airpower are as follows:

2.1.1 Examine the application of the military instrument of national power.

2.1.2 Stress the concepts in the document *Global Reach/Global Power* by emphasizing airpower's inherent advantages in speed, responsiveness, range, flexibility, firepower, stealth, and precision.

2.1.3 Examine the impact of projected aerospace force structure upon national security.

2.1.4 Improve the understanding of senior government, civic and military leaders of the utility and efficacy of airpower.

Compare these objectives to those for the *Joint Land, Aerospace, and Sea Simulation (JLASS)*, a seminar wargame held for select members of each of the senior service schools:

a. promote the education of all participants through an active learning process addressing issues at the strategic and operational levels of war;

- b. promote jointness, recognition of coalition issues, and enhancement of resident instructional programs;
- c. improve operational and strategic level wargames, simulations, and exercises;
- d. enhance and expand senior service college awareness of concerns in the general technical development of exercise design, content, and results;
- e. use and improve our expertise in computer-assisted wargaming; and
- f. expand logistic and sustainment play to illustrate impacts at strategic and operational levels.

The reason for including these lists is to provide a sample of the different types of objectives found in Wargaming Center wargames. The lack of a uniform or standard listing of education objectives made it difficult to develop a set of MOEs against which to evaluate the candidate commercial wargames. For this reason, I reverted to the overall objective of teaching the employment of aerospace power and consulted Air Force Doctrine in a search for MOEs.

3.3 Air Force Doctrine

Air Force Manual 1-1, Volume II defines the Roles and Typical Missions of Aerospace Power.

2-4. Aerospace forces perform four basic roles: aerospace control, force application, force enhancement, and force support.

2-4a. Aerospace control assures the friendly use of the environment while denying its use to an enemy.

2-4b. Force application brings aerospace power to bear directly against surface targets.

2-4c. Force enhancement increases the ability of aerospace and surface forces to perform their missions.

2-4d. Force support must sustain operations if aerospace forces are to be successful[6:103].

The next paragraphs will identify and briefly describe the missions typically associated with each of these roles. Bear in mind that various assets (aircraft, cruise missiles) have different capabilities to perform many of these missions. It is the

commander's responsibility to select the asset which can best perform the mission in the overall context of the battlefield environment, subject to any restrictions (political, doctrinal, etc). Providing future commanders with experience in this decision making process is exactly what the Air Force Wargaming Center is supposed to do.

Aerospace control (establishing air supremacy) usually includes counterair and counterspace missions. Counterair can be in the form of offensive counterair (OCA) or defensive counterair (DCA). **OCA** missions typically take the initiative in an attempt to destroy the enemy's ability to operate in the aerospace environment by attacking his offensive systems (aircraft, cruise missiles, etc.). **DCA** missions are designed to protect friendly forces from incoming enemy offensive systems, i.e. shooting down attacking aircraft before they can attack. The counterspace mission exceeds the scope of this thesis and is therefore not considered.

Force application is typically thought of in three ways: through strategic attack, interdiction, and close air support. **Strategic attacks** are directed against the enemy's ability to produce or sustain military forces, like ammunition factories, aircraft factories, ball bearing factories, etc. **Interdiction** is designed to destroy, delay, or disrupt enemy surface forces prior to their reaching the Forward Edge of the Battle Area. Interdiction includes attacks against supply lines and lines of communication which can directly affect the enemy's ability to fight. **Close air support** is the direct application of air power upon enemy surface forces, either in support of friendly offensive or defensive surface combat operations.

Force enhancement normally has the following missions associated with it: airlift, air refueling, spacelift, electronic combat, surveillance and reconnaissance, and special operations. **Airlift** is essentially the ability of air assets to provide increased mobility and combat capability to ground units through airborne movement and supply. **Air refuelling** provides increased range capability for friendly air units and increases combat capability through the extension of range and loiter time (the time friendly air units can remain in the target area). **Spacelift** is beyond the scope

of this study, but the basic concept requires the replenishment of fuel supplies for space-based platforms provided the cost could be justified by the results. "Spacelift does for space platforms what airlift does for terrestrial forces"[6:107]. **Electronic combat** has become a very important mission in recent years. It deals with denying the enemy use of the electromagnetic spectrum through electronic countermeasures (ECM), such as jamming, while ensuring friendly use of that spectrum through electronic counter countermeasures (ECCM). **Surveillance and reconnaissance** is of vital importance because it provides information concerning the enemy's force disposition and intentions. Reconnaissance includes the over-flight of enemy territory to gather information on troop dispositions, base activity, etc. Surveillance includes monitoring the enemy's activities and would include the mission of Airborne Warning And Control (AWACS) aircraft as well. Knowledge is power on the battlefield. The side which knows where the enemy is and what he is doing has a distinct advantage.

Finally, **special operations** will not be considered in this study.

Special operations forces are essentially a composite force, capable of performing a variety of traditional aerospace roles and missions in unique and specialized ways in such areas as unconventional warfare, counterterrorism, foreign internal defense, special reconnaissance, and direct-action operations[6:109].

Special operations involve many highly specialized types of situationally dependent operations which have a distinct influence on various battlefield parameters. Modeling them in an aggregated manner would cause loss of the fidelity required to "see" their impact on the battle. Since all of the wargames chosen for this study are aggregated models, the high resolution effects of special operations are lost, therefore special operations are not considered.

Force support involves the sustainment of friendly combatants. This includes base operability and defense, logistics, combat support, and on-orbit support. **Base operability and defense** deals with locating, constructing, and maintaining the operation of friendly bases. This includes protecting the bases from attack and

repairing them as quickly as possible should they be attacked. In a few words, the logistics mission could be summed up as ". . . getting the right thing in the right amount to the right place at the right time"[6:107]. Logistics deals with combat requirements like spare parts, ammunition, fuel etc. **Combat support** includes such things as ". . . administration, chaplain, civil affairs, finance, legal, health, security, topographic and geodetic, food, graves registration, laundry, dry cleaning, bath, and other services[6:107]. As mentioned earlier, I am not aware of any commercial wargame which addresses combat support as a separate entity. Some commercial wargames do attempt to include these items in their supply rules, but it is so abstract as to be indistinguishable. **On-orbit support** again exceeds the scope of this thesis. It would involve the ability to control and maneuver space-based systems from ground stations in order to utilize these assets in a productive manner against any potential enemy.

These roles and missions provide the basis from which the MOEs for the evaluation of the wargames in this study were derived. If the chosen wargames were able to simulate these roles and missions, then the commercial wargame would likely be of some educational value. These MOEs can be found in section 3.5.4.

3.4 Modeling Expertise

The process of gaining combat modeling expertise was accomplished primarily through two AFIT courses taught by Major Ed Negrelli, USA. Both courses were titled *Land Combat Modeling*, but the first course concentrated on high resolution modeling techniques while the second one addressed aggregated modeling techniques[22:]. The major written sources were handouts by James Hartman which described the high resolution and aggregate combat modeling processes in great detail. High resolution models simulate individual combatants as separate entities. As such, they require extensive processes for the search, detection, acquisition, and engagement of individual men, tanks, guns, aircraft, etc. The scale is such that the

order of resolution of each fired weapon has a distinct impact on the battle[14:]. In other words, assuming a one-on-one tank engagement, if my tank kills your tank before you get a chance to shoot, then you never get the chance to kill my tank. Aggregated models do not work that way. An aggregated model is one in which the basic model entities are groups rather than individual combatants. Instead of seeing every individual tank which comprises a battalion, we see only a single battalion counter. The term counter refers to the cardboard representations of combat units that are used in commercial board wargames. These aggregated models can be homogeneous or heterogeneous.

A homogeneous aggregation is one where the combat power of the unit is combined into a single measure (or perhaps one combat power index for ground weapons and another for aircraft). Attrition computations are then based on the relative power of the two forces in a battle, often by computing the ratio of their combat power indices.

In a heterogeneous aggregated model, the aggregated unit maintains a count of the number of surviving weapon systems of each distinct type. This allows modeling of the differing effectiveness of a firer weapon type against various types of enemy targets[15:4].

Hartman points out in his writing that high resolution models are limited by the size of battle they can simulate. At the time of his writing, 1985, a maximum of approximately 1000 entities were about all that any high resolution model could handle. For that reason, aggregated models were the only ones that could simulate division, corps, or larger scale battles. In recent years, advancements in computer technology and communication systems has made it possible to network training facilities from all branches of the armed services into a single, high resolution battle. The capabilities to model high resolution division size and larger engagements now exist. Because of these advances, it is my opinion that future trends will include more and more high resolution models because of their ability to provide more traceable data. This data makes it possible to follow the actions of individual entities to see

exactly what impact each had on the battle. This ability to examine precisely what happened to small entities is a feature that many users of models seem to desire.

Hartman's theories are still valid in the world of commercial board wargames and probably will remain so forever. The main reason for this is size. High resolution board wargames do exist, but they are all small unit actions. *Advanced Squad Leader (ASL)* by Avalon Hill is a prime example. *ASL* represents small unit actions from World War II. The basic units are the infantry squad, which represents 8 to 13 men; the tank where each counter is exactly one tank; and artillery where again each counter represents one gun. One game turn represents two minutes of actual time. An individual mapboard has hexagons which represent 40 meters of actual terrain from side to side. A standard board (which measures 8 1/2 by 22 inches) therefore represents an area of 400 by 1240 meters. To simulate a battle area 70 miles wide by 100 miles deep (the approximate area encompassing the Battle of the Bulge) would require 36,660 *ASL* mapboards! This would require a playing area roughly 238 by 200 feet. One 24 hour period would require 720 game turns. The number of counters needed to represent all of the divisions which fought in the battle would number into the hundreds of thousands. Imagine how long it would take to move 100,000 counters 720 times. The cost of such a wargame would be staggering. As an example, Avalon Hill sells individual *ASL* mapboards for \$5.00 a piece. This would indicate a cost for mapboards alone of \$183,300, and this doesn't include the playing pieces, rules, or container in which to store the game. I think it is safe to say that high resolution models of large scale battles will not appear in a board wargame format. This could become a distinct disadvantage for commercial board wargames as high resolution computer models gain more and more capability.

Commercial computer wargames are a different story. With the continued advances in personal computer technology, it is conceivable that high resolution, large scale battles may one day be possible. The latest computer wargames feature impressive graphics, user friendly pull-down menus, and from a hobbyists point of

view are superb for solitaire play because the computer can assume the role of the other side. These factors help illustrate why the future looks bright for computer wargames and also provide a possible explanation for the declining sales of board wargames.

3.5 Wargame Evaluation

The wargame evaluation process required some sort of logical sequence of events in order to ensure each wargame received the same treatment. The process began with an overview of the wargame, designed to provide familiarity with the components and scenarios. The next step involved learning the rules and making an initial assessment of their completeness and realism. With the rules understood, it was then possible to begin play of the wargame. After playing each wargame several times, I was then able to evaluate it against the MOEs established earlier.

3.5.1 Wargame Overview and Components. The wargame overview process would normally begin with a general familiarization of the conflict being simulated. It is important to understand the factors which led up to the battle, the objectives of each side, the general composition of the opposing forces and their quality, the terrain over which the battle was fought, etc. In short, the more you know about the individual battles, the better equipped you will be to grasp the nuances of the wargame. Fortunately, due to my intense interest in military history, I had already read accounts of all the historical battles represented by the chosen wargames.

The process of gaining familiarity with the components was slightly different for board wargames than computer wargames. For board wargames, this included laying out the mapboards, counters, combat results and terrain effects tables (and any other tables the game may have contained) and scenarios. Obtaining a thorough familiarization of the game components made understanding the rulebooks much

easier. It also provided a "feel" for the game as far as the types of units simulated and the goals of each side.

The computer wargames were each unique. *Command HQ* had a pair of tutorial demonstration games which stepped you through each of the combat and movement processes. Two games, *Conflict: Korea* and *Conflict: Middle East* contained rather extensive rulebooks which included maps of the playing area. These proved very valuable in the learning process because I was able to familiarize myself with all of the game's terrain features and mechanics of movement prior to play. *Air Force Commander* provided no maps or tutorials. In fact, the rulebook was extremely vague and proved of little assistance. Consequently, familiarity could only be gained by experimenting with the actual play of the game. This proved very frustrating because the model plays so quickly that it took over a dozen games just to master the basics. After playing over 100 games I was still learning things about the model. Except for *Air Force Commander*, the familiarization process provided valuable insight which made the learning process much easier.

3.5.2 Rules. The rules are quite possibly the single most important element of any commercial wargame. Without a set of comprehensive, understandable rules (including good examples) it is virtually impossible to have a realistic game. As a general rule, the more realism a game simulates, the more extensive the rules will have to be. Additionally, the larger the scope of the battle, the more rules the game will require to properly simulate each aspect. These are generalized statements about the extent of rulebooks, not hard facts. As a way of illustrating this, consider a game which simulates a regiment/brigade level battle. If the game is designed as an aggregated model containing no artillery, headquarters, or air units, the result could be something as simple as Avalon Hill's original design, *The Battle of the Bulge*, circa 1965. This game has a four page basic rulebook which focuses primarily on the mechanics of movement and ground combat. Adding artillery units to this game would require additional rules to cover the longer range capability of these units,

as well as how they move, attack, and defend. Incorporating headquarters units would require rules addressing command and control issues, as well as rules for the headquarters movement and defense. Adding the air component would require rules addressing all the mechanics of aircraft movement and combat, as well as rules for anti-air defenses. Thus my statement that the degree of realism desired will dictate the extensiveness of the rules.

Reading the rulebook(s) of each wargame was in a few cases sufficient to eliminate the model from consideration. *Air & Armor* provides an excellent example. The catalog descriptions and the information printed on the wargame box all implied that this was an operational level wargame simulating both air and ground combat. Unfortunately, after reading the rulebook and the designers notes, it was obvious that the wargame was unacceptable because the air war had not received proper attention. The designer writes:

Air & Armor originally had a very detailed, very complex air game. Each individual anti-aircraft battery was depicted, players could select the type of ordnance each air strike carried, and aircraft physically moved across the map, taking anti-aircraft fire each time they moved within range of enemy anti-aircraft assets. However, there were three major problems with this. The first was the question of role: who was the player, the ground commander or the air commander? The two perspectives were very different, almost requiring two players per side. The second was that the level of complexity did not affect play: the outcome on the ground was similar no matter how much air detail was added. The third was that the playing time was very long[21:30].

This quotation illustrates three major concerns for any game designer: the focus of the game, the complexity, and the playing time. In an effort to produce an enjoyable game that would hopefully have good sales appeal, the air component of this game was simplified to a level that makes it unsuitable for addressing the issues of the application of aerospace power. This in no way makes *Air & Armor* a bad wargame, it simply means the game is inappropriate for the Air Force Wargaming Center. Additional details regarding *Air & Armor* can be found in chapter 4.

3.5.3 *Wargame Play.* The process of actually playing the games provided a measure of the completeness of the rules and an assessment of the realism of the wargame. It was also the only way to observe the actual combat and movement processes, as well as all the other game mechanics. In addition to the above, I was also looking for ways to "game" the system, i.e. to utilize obscurities in the rules to gain an advantage that does not exist in real life. To illustrate this, let me describe one way to "game" the system in one of the classic Avalon Hill games, *Stalingrad*. For those familiar with Hitler's invasion of Russia, you will recall that in the early months of the war, the German army was able to use blitzkrieg tactics, to capture huge sections of Russia and hundreds of thousands of troops. *Stalingrad* has no rules designed to model blitzkrieg tactics making breakthrough and exploitation impossible. The standard Russian strategy when playing *Stalingrad* has become one of defending river lines strongly and placing weak units out in areas of open terrain. These units are easily destroyed each turn, but the rules prohibit the German player from advancing beyond them. Among expert players, the Russian player can prevent the German player from reaching the city of Kiev for a minimum of 9 months. It took less than two months historically. For the purist seeking a true simulation of the battle, *Stalingrad* is not the answer, however it is regarded by many wargamers as one of the "classic" wargames ever produced (and one of my all-time favorites).

3.5.4 *Measures of Effectiveness.* "Measures of effectiveness are the criteria that are common to the evaluation of all competing alternative systems and are used to evaluate each system in terms of the objective..."[3:2-8]. There were two issues of concern in evaluating commercial wargames. The first was whether the wargames were doctrinally sound. If the candidate wargames failed to properly address Air Force Doctrine regarding the employment of aerospace power, then there would be no reason to look at the second issue, implementation. By implementation, I am referring to such things as: the time it would take to set-up the game, teach the users how to play, conduct the play, collect and publish the results, and provide feedback.

If any of these implementation concerns proved too costly, time-consuming, or difficult, then even a doctrinally sound wargame could also prove unsuitable. This thesis will focus only on the doctrinal issue, therefore any commercial wargames found doctrinally suitable will still require an assessment of their implementation. The MOEs used in the evaluation of the candidate commercial wargames were developed directly from the Air Force Doctrine covered previously utilizing evaluation techniques covered in AFIT courses on *Land Combat Modeling*. The MOEs are as follows:

- **Aerospace Control.** Does the wargame provide a simulation of the struggle for air supremacy and reward the side which achieves it? Some wargames just assume one side will have, or shortly gain, air supremacy and thus ignore or grossly simplify this process.
- **Strategic Attack.** Does the wargame simulate strategic attacks designed to destroy or neutralize the enemy's ability to produce or sustain military forces or his will to use those forces?
- **Interdiction.** Does the wargame simulate interdiction attacks against supply lines and lines of communications which the enemy would need to sustain and control his forces in a combat environment?
- **Close Air Support.** Are both defensive and offensive close air support attacks modeled?
- **Airlift.** Is airlift of troops and/or supplies to enhance mobility and combat effectiveness modeled?
- **Air Refueling.** Is air refueling to extend the combat range of aircraft modeled?
- **Electronic Warfare.** Is electronic warfare, both ECM and ECCM modeled?
- **Surveillance And Reconnaissance.** Is surveillance and reconnaissance modeled? If so, do the assets actually have to over-fly enemy territory, or does the

wargame simplify this procedure? Some wargames don't model surveillance at all and allow perfect intelligence for both sides.

- **Base Operability And Defense.** Is base operability and defense modeled? Some wargames provide a certain degree of airpower which is based "off board" and therefore ignore basing issues completely.
- **Logistics.** Are logistics issues modeled? Some wargames, especially those which simulate short time periods, ignore logistics issues completely or else claim to factor them into the combat process.
- **Combat Support.** Is combat support modeled? The answer to this question is no in all cases. No commercial wargame that I am aware of addresses combat support as a separate issue. The wargames that do address logistics refer to it as supply and, in most cases, imply that it includes combat support.

In addition to these MOEs which evolved from Air Force Doctrine, the following MOEs are also significant factors in the proper application of aerospace power.

- **Weather.** Is weather modeled? If so, how is the effectiveness of individual combat units affected by it?
- **Day/Night.** Is day/night modeled? As we saw in Desert Storm, night combat capability can provide one side with a huge advantage if they are properly equipped and the enemy is not. Besides, F-117s were designed to operate at night.

For every wargame evaluated, each of the above MOEs was assigned one of the following subjective rating levels:

- **N** - The wargame does not address this MOE at all.
- **S** - The wargame includes the MOE process and provides a satisfactory simulation of it.

- R - The wargame acknowledges this MOE but provides only a rudimentary simulation of it which has little or no education value.
- I - The wargame attempts to address the MOE but the simulation is inaccurate, incorrect, or teaches an incorrect lesson.

3.5.5 Additional Considerations. The MOEs identified above provide a fairly good picture of whether a commercial wargame is suitable for teaching the application of aerospace power, but a number of other factors are also of interest. These factors could be thought of as the general characteristics of the game and include:

- Map scale
- Time scale
- Unit scale
- Complexity of the Rules (how long would it take to learn to play?)
- Documentation (Completeness and Realism)
- Playing Time
- Number of Players
- Playing Requirements (how large a playing area for board wargames, what type of computer requirements for computer wargames)

3.6 Wargame Modifications

Merely identifying that a wargame was unsuitable to fulfill the Wargaming Centers education objectives was not the final step. It was possible that a wargame may have addressed many pertinent issues and perhaps, with relatively minor modifications it would be possible to adopt the wargame to suit these education needs. The final portion of analysis was designed to make a qualitative judgement of this

very issue, and where possible, identify the corrections needed to enable the use of the wargame. Again, this was necessarily a subjective issue based on the opinions of the author, and following the assumptions of the specified MOEs.

IV. Wargames Not Included In This Study

4.1 Introduction

As mentioned earlier, there are thousands of commercial wargames available covering just about every historical battle ever fought and countless more which address hypothetical future conflicts. Section 1.4 includes the constraints used to narrow the list of wargames considered by this study. The purpose of this chapter is to provide the reader with insight as to why certain wargames which did include air components were not included in this study. It is **not** intended to be an all-inclusive chapter listing every single wargame. Rather, it is designed to illustrate just what factors made a particular type of wargame inappropriate through the use of examples. This should provide the necessary insight to allow the reader to draw parallel conclusions about any particular wargame not included in the study or specifically listed in this chapter.

4.2 Tactical Level Wargames

There are an extensive number of commercial wargames available that represent combat on the tactical level. As mentioned earlier, these games just do not teach the concepts of aerospace power because they are simply too restrictive in nature. For example, games like *Panzer Leader*, *MBT*, *The Arab-Israeli Wars*, *Advanced Squad Leader*, and *Squad Leader* (all by Avalon Hill) and GDW's *The Sands of War* all focus primarily upon tactical level ground warfare. Each of these wargames do contain rules for close air support and scenarios which include one or more aircraft and/or helicopters. The air units have an unlimited movement allowance and enter the board only to provide close air support. The player has no control over the type or number of aircraft allowed in the scenario. Occasionally, some wargames may allow the player to choose whether the aircraft will be armed for attacking infantry or tanks, but usually the scenario specifies the armament as well. The game

mechanics essentially turn the aircraft into highly mobile artillery units with fairly deadly firepower, but limited ammunition. While this might provide some insight into the effects individual aircraft can have on a tactical battle, it is the only lesson of aerospace power that can be gleaned from these games. Additionally, the aircraft components make up such an insignificant portion of the play of these particular wargames as to make them totally unsuitable for use at the Air Force Wargaming Center.

Tactical level air-vs-air games are a different matter. Games such as *Flight Leader*, *Airforce*, and *B-17* by Avalon Hill and *Basic Fighter Combat* and *Advanced Fighter Combat* by Gamescience Corporation all focus primarily on air-to-air combat between small numbers of aircraft. Most of these games also contain rules for conducting various ground attack missions (both tactical and strategic) as well as providing fighter escort of bombers. As such, they do cover more of the MOEs than the first set of games, however the scale is still incorrect. The game scenarios provide the orders of battle for each situation, identifying exactly which role each side is trying to achieve. The battles represent small numbers of aircraft and each battle is a separate occurrence, not part of an overall campaign process. Remember, the objective of the Wargaming Center is to teach the employment of aerospace power, not individual aircraft tactics, which is exactly what these games are modeling.

The great majority of the computer games available seem to focus on this tactical level as well. I feel part of the reason for this is the arcade value appeal of "climbing into the cockpit of a jet fighter" and taking on the world so to speak. The prime motive for commercial wargames is to make a profit, which is especially true in the computer software arena. People buy games like *F-15 Strike Eagle*, *F-15 Strike Eagle II*, *F-15 Strike Eagle III*, *F-117A*, *F-14 Tomcat*, *F-16 Combat Pilot*, *Ace of Aces* (and the list goes on and on) because they want to try their hand at flying modern jets or the great warplanes of past wars. All of these games are designed to allow a single player to "fly" combat missions. Depending on the game,

you can have dog-fights with just about any type of aircraft or make ground attacks on just about any type of target you care to imagine. The games usually utilize a joystick, which adds to the simulation because it provides the feel of having the stick in your hands. Unfortunately, it also adds the requirement of good hand-eye coordination in order to be successful, a skill that is definitely not required by a battle staff or a successful Theater-level commander. These games are usually great fun to play once you master the control sequences, but would offer senior military officers virtually no insight into the proper application of aerospace power. Again, this is not a condemnation of the games in any sense. These games were simply not designed to model the roles and missions of aerospace power.

4.3 *Naval Wargames*

Another group of wargames focus primarily on naval battles. Board wargames like *2nd Fleet*, *3rd Fleet*, *5th Fleet*, *6th Fleet*, and *7th Fleet* by Victory Games, and *Midway*, and *Flat Top* by Avalon Hill, as well as computer games like *Harpoon*, *Carriers at War*, and *Carrier Force* all include extensive coverage of airpower. Unfortunately, these games have no ground combat, so lessons about interdiction, close air support, base support, and air transport are not modeled. The games focus a great deal of attention on combat processes between ships and submarines. These games are really more appropriate for use by (and some have been used, see chapter two) the Navy and as such were not included in this study. That is not to say that the Air Force would never be called upon to attack enemy fleet units, but the fact remains that very few other countries in the world possess a naval capability that poses a major threat to the United States. For these reasons, the training and education of naval tactics are more appropriately left to the true experts, the U.S. Navy.

4.4 Theater Level Wargames

Another category of board wargames are those which represent aggregate models of theater level battles. Games such as *The Russian Campaign*, *The Battle of the Bulge*, *Panzergruppe Guderian*, *Flashpoint: Golan*, *Airland Battle*, and *Air & Armour* all focus primarily on the ground battle, however they all include some abstracted level of airpower. In *The Russian Campaign*, airpower appears in the form of three Stuka counters for the German player. Each counter can be used to increase the combat odds of one battle per turn by three columns in favor of the attacker. The number of Stukas available can be decreased due to weather, with only one available in 1941 or 1942 turns when "mud" is rolled and zero available in turns when "snow" is rolled. Additionally, the number of Stukas available decreases by one each year until zero are available for 1944 and beyond. The only airpower the Soviet player has appears in the form of three parachute units which each can be dropped one time. This is the entire representation of airpower in the game.

In *Panzergruppe Guderian*, the sole function of airpower is in an interdiction capacity, which does not damage or degrade the combat capability of any ground combat units. All it does is delay the ability of these units to reach the front lines.

In the original version of *The Battle of the Bulge*, circa 1965, there are no air counters at all. The Tournament Game rules provide automatic air supply for all American units and an arbitrary interdiction effect which reduces the movement factor of all German units. The only stipulation is that the weather has to be "clear" before either of these capabilities go into effect, however, once the weather clears it remains that way for the duration of the game. Optional rules provide twenty tactical airpower factors that can be used in support of American ground attacks, but each factor can only be used once. Another optional rule allows for a single strategic attack versus one hex. This attack is capable of destroying the entire contents of the hex on a roll of 1 or 2, destroying up to two combat units in the hex on a roll of 3 or 4, or simply immobilizing all contents of the hex for

one complete game turn (12 hours of actual time) on a roll of 5 or 6. Avalon Hill released a new version of *The Battle of the Bulge* in 1981. This game features an entirely new mapboard, a new and much more accurate order of battle, new units which reflect more historically accurate combat strengths, and a new, much more comprehensive rulebook. This version incorporates rules for artillery units and a much better representation of airpower. The game provides airdrop rules for the German Von Der Heydte parachute battalion, and an entire page devoted to tactical and strategic airpower. The game even provides limited airpower assets to the German player. Despite these considerable improvements, this game is still far from suitable for teaching the roles and missions of aerospace power. Air units may only fly interdiction (U.S. only), and close offensive and defensive air support missions. Interception is not possible, although the game states "German air power has been reduced to reflect the interception of most of the scheduled aircraft east of the battle zone"[26:10].

In *Flashpoint: Golan* by Victory Games, Inc., the air war is represented "...in a highly abstract fashion for the sake of speed and ease of play"[2:32]. The reasons for this are as follows:

The qualitative advantages of the Israeli Air Force are such that any realistic air system must virtually guarantee that it will win Air Superiority in short order. Given this situation, it would have been ridiculous to spend a lot of game time (and add a great deal of complexity) simulating an air war whose end result was virtually a foregone conclusion[2:32].

Quite a few other commercial wargames adopt this same approach because the historical battle the game is simulating featured total air superiority by one side or the other.

According to the various catalog descriptions and the game box, *Air & Armor* by West End Games sounded like it would be the perfect wargame. This game contains some very interesting procedures to simulate a number of factors that have become important in modern ground combat, unfortunately, the air component is so

badly abstracted that I would suggest "Air" should be deleted from the title. The game does provide several employment options for helicopter assets, however fixed wing aircraft may as well be non-existent. The players have no control over the number or types of aircraft available. Each scenario assigns a number of airpoints to each side. The player can expend one airpoint anytime during the game. For each airpoint spent, the player is allowed to roll one ten-sided die and consult the air table which will reveal the number and type of aircraft that appear. The player can spend an extra point prior to the die roll which will allow an additional two aircraft to be added to the number that results from the die roll. The die can provide from two to four allied aircraft, or from four to six Soviet aircraft. These make up the total number of aircraft that can participate in one ground strike on one enemy ground target. They may not combine their attack with any ground fire. There are no provisions in the game for friendly aircraft to intercept enemy aircraft, or to perform any other mission than the ground strike described above. The net result is that aircraft have a very small effect on the battle, if any at all. It should be obvious to the reader that this game is totally incapable of teaching the proper employment of aerospace power.

Airland Battle by Omega is quite similar to *Air & Armor*, although it makes a better attempt at airpower. This game allows air units to perform air interdiction or close air support missions. Each side gets a specified number of generic "Air Interdiction" or "Close Air Support" units each day for use in either the AM, PM, or Night turns of that day. Once an asset is used, it may not be used again during that day. Any asset shot down is permanently removed from play, thus affecting the number of assets of that type available in later game turns. For example, if the scenario specifies the Soviet player receives 8 "Close Air Support" units and two get shot down on the first game turn, then only six will be available for subsequent game turns. In addition to the above air capabilities, the American player gets one "Air Suppression" unit which can be utilized to degrade the anti-aircraft ability of Soviet

air defense units. There are no other air missions simulated in this game, so once again it is fairly obvious that the focus of the game is on the ground portion of the battle and therefore unsuitable for use at the Air Force Wargaming Center.

These are just a few of the many wargames which include an abstracted measure of air power, but hopefully these examples serve to illustrate the types of limitations that exist in the great majority of the commercial wargames.

4.5 Strategic Wargames

This category includes games which represent grand strategic level conflicts like World War II. One of the best examples here is Avalon Hill's *The Rise and Decline of the Third Reich* which is available in both board wargame and computer wargame formats. This game has an extensive rulebook and the mapboard incorporates all of Europe, most of Russia, and the northern coast of Africa. The game includes ground, naval, and air units, as well as a system of Basic Resource Points (BRPs) which are used to conduct offensive operations, build/rebuild forces, and declare war on other countries. Each turn represents three months of actual time. The air units of every country have the same generic movement allowance and combat capabilities. The game allows interception missions, offensive and defensive close air support, counterair, and naval attack missions. Unfortunately, primarily due to the scale, the number of aircraft available to any one country is fairly limited. The Germans can have a maximum of 30, the British 20, the French 10, the Italians 10, the Russians 15, and the U.S. 20 combat factors in play on any given turn. Each of these factors has the ability to perform any of the game's air missions with equal capability which has the effect of turning a particular air factor into a fighter one turn and a bomber the next. Also, the range of every air factor is four hexes. The single biggest limitation is each air factor can only perform one type of air mission for what amounts to three months!

Strategic attack is not possible, although the game provides a strategic warfare capability. Basically, the U.S. and British player can spend BRPs to build either Strategic bombers or Anti-Submarine Warfare (ASW) ships. The German player can build either submarines or fighters. Each fighter destroys a strategic bomber in a one for one exchange. Each surviving bomber then deducts two BRPs from the German total. The submarines and ASW work the same way, with each submarine deducting three BRPs from the U.S./British total. This strategic warfare phase occurs once a year and the sides are limited to the amount of BRPs they can spend in building strategic warfare assets. To make matters worse, submarines and fighters cost two BRPs each, while ASW and bombers cost three, a distinct advantage for the German player. While the above is an aggregated attempt to model strategic warfare, it does not begin to teach the proper employment of air assets in a strategic role.

Once again, although on the surface this game seems like it might address a number of issues concerning the application of aerospace power, the main focus of the game is clearly the ground war. The game does illustrate the importance of airpower in the sense that a ground offensive will accomplish very little in the face of large amounts of enemy defensive air support unless friendly aircraft are available to intercept. Unfortunately, the ability of this game to teach the proper application of aerospace power is extremely low.

Command HQ is a computer game which attempts to model global conflict. The game provides five scenarios, covering World War I, II, III, IV, and V. Each succeeding war offers more options. The gamemap shows the entire world, but only 50 major cities and 12 bases appear. For example, Madrid is the only city in Spain, and places like Portugal, Belgium, and the Netherlands have no cities at all. In fact, no international borders appear on the map. There is only one type of generic air unit available in the game. Air units can be based in cities, on bases, or aircraft carriers. They can attack ground, naval or other air units, but only one air unit at

a time can perform any mission. Interception missions are performed automatically by the computer. The player has no control of these interceptions, nor do you get any warning that an air attack is in progress until the bombs start falling. No other options are available for air units, and they play such a small role in the overall conflict as to make this game completely unsuitable for teaching the roles and missions of aerospace power.

There are dozens of other games that have been, or are currently, available addressing global scale conflict. Old SPI games like *USN*, *War in the East*, and *War in the West* as well as current games like *Pacific War* by Victory Games and TSR's *World War II (Europe)*, and *World War II (Pacific)* all make extensive attempts to cover global scale conflict including the air war. The problems with these types of wargames are the extensive focus on issues other than airpower and their scale. Airpower tends to play an important role in these games, but it is such a small element of each turn, or the turns represent such large amounts of time, that the games just don't have the ability to challenge the modern air commander with the problems he/she would face in a modern war.

4.6 Hypothetical Wargames

Hypothetical wargames as used in the context of this discussion refer to games designed to simulate battle on some hypothetical continent, between two hypothetical countries. In other words, everything is fictional. *Tactics* which is generally regarded as the very first commercial wargame ever produced was just such a game, but since it contained no air units, I will address the Avalon Hill game *Blitzkrieg* instead. *Blitzkrieg* was originally designed in 1965, with a complete rewrite of the rules in 1975. It pits the military forces of two fictional countries, (Great Blue and Big Red) against one another on a battlefield depicting both countries as well as several minor neutral countries which lie between them. These minor countries have no military forces per se, however, before they are considered conquered, each of their

major cities must be captured. This is accomplished through a special city capture process that is capable of inflicting combat losses on the attacker. *Blitzkrieg* does incorporate Tournament rules which address issues like invasions, artillery, rangers, and yes, aircraft.

The game provides TAC (tactical bombers), MDM (medium bombers), and SAC (strategic bombers) bomber units and Fighters. Each aircraft type has a different movement allowance and different combat capabilities. Fighters may: intercept, escort, strafe grounded air units, and patrol. TAC and MDM bombers may provide close air support to attacking ground units. MDM and SAC bombers may conduct bombardment attacks of enemy units not in contact with friendly ground units. Additional bombing missions include:

- TAC and MDM air units may bomb airbases. This attack can destroy enemy air units on the ground, but it has no effect on the base itself.
- SAC and MDM air units may bomb a port facility. A successful attack negates the port for one complete gameturn.
- SAC and MDM air units may bomb a city-road. A successful attack negates the use of the city hex for road bonus or as a link in a supply line for one complete gameturn.
- SAC and MDM air units may bomb city supply and industry. A successful attack negates the use of the city as a supply source and negates its replacement and industrial capacity for one complete gameturn.

The game also has a rule for night bombing, which degrades the bombing capacity of the bombers participating, but has the benefit of not being interceptable by enemy aircraft. The game does not address airlift of supplies, although it does allow parachute drops of the four airborne units possessed by each side. Additionally, no DCA, air refueling, surveillance and reconnaissance, ECM and ECCM, or combat support issues are modeled.

Another limiting factor is the small number of air units available to each side. Each country has only 16 SAC, 12 MDM, 8 TAC and 16 Fighter factors. The game allows each individual factor to be utilized independently of the other factors, or in any combination the player desires, subject to the rules. Up to four TAC or Fighter factors may be based at sea to simulate aircraft carriers. All other air factors must be in a city (which acts as an airbase as well). As mentioned above, there is no way to destroy any airbases in the game. Command and Control issues are not modeled at all, and each side has perfect intelligence of the disposition and combat capability of enemy forces. Combat resolution is based entirely on the number of air factors in the battle. The larger number available, the greater will be the effects of the attack.

This game probably comes the closest to being a suitable model of all the games listed in this chapter, but once again, the main focus of the game is on the ground mechanics. The small number of air units, and the comparatively short ranges of the aircraft, 8 hexes for TAC, 10 for MDM, 12 for Fighters, and 20 for SAC really limits what an individual player can accomplish with air power. For these reasons, it is the judgement of the author that this game does not address the roles and missions of aerospace power in a sufficient manner to be a viable candidate. Besides, this game is designed and really only suitable for two players which would make it rather difficult to use for the education of entire air staffs.

4.7 Air Campaign Wargames

This last type of wargame focuses only on the air component of a given battle. The Battle of Britain was the first great air battle of history where the combatants relied solely on airpower to win or lose the battle. The Avalon Hill game *Luftwaffe* will serve as the example here.

Luftwaffe is a game designed in 1971 to simulate the American daylight precision bombing campaign against Germany in World War II. The basic game consists of a single raid sequence lasting up to 20 turns designed to acquaint players with the

mechanics of movement and combat. The Tournament and Advanced games consist of ten quarters with one 20 turn raid sequence possible in each quarter, therefore the game represents two and a half years of bombing. The German player is provided only with the various interceptor units that participated in the battle. They have absolutely no offensive capabilities and can only begin intercepting incoming American planes as they appear over occupied territory. The American player has both bomber and fighter escort aircraft. They are allowed to attack enemy airbases which, if successful, eliminates the base for that quarter only. This really has a minimal effect on the German player since far more German airbases exist than German aircraft units. American fighters can sweep ahead of the bombers and try to attack airborne German units or strafe them on the ground, or they can be assigned close escort missions designed to protect the bombers. The main focus of the game is on the bombing of the German aircraft production plants (43 separate targets) in the Tournament game, or all cities on the board (79 separate targets) in the Advanced game.

The number of air units available to each player changes from turn to turn. For example, the American player begins the first quarter with only two B-17, one B-24, and one P-38 unit. For the second quarter, the P-38 unit is removed and two P-47 units arrive. Each of these units counts as two factors for air combat. Since only bombers can bomb cities, the American player has the capability of bombing only three targets per turn for the first two turns. Additionally, in 1943 the American bombers are only allowed to operate from Britain, so the area of the map where they can enter play is very small. This allows the German player to concentrate his interceptors, making a successful raid in the first two quarters almost impossible. In 1944 and 1945 they may operate from Italy and Great Britain, forcing the German player to split aircraft units between the two fronts.

Although some may feel *Luftwaffe* provides useful insight into a strategic bombing campaign, the advancement of technology has made the high-altitude, daylight

precision bombing attack completely obsolete. Single F-117s, flying at night, carrying two laser guided precision bombs were able to destroy targets that would have required hundreds of B-17s in World War II. Since the main premise of the strategy modeled in *Luftwaffe* is obsolete, and due to the limited types of air missions modeled, the game is unsuitable for teaching the modern roles and missions of aerospace power.

4.8 Conclusion

This chapter has attempted to provide examples of the numerous types of commercial wargames currently available. Hopefully it has provided valuable insight as to why each type of commercial wargame was deemed unsuitable for use at the Air Force Wargaming Center. I must reemphasize that this chapter does not contain an all-inclusive list of every commercial wargame available. The reader can use these examples, along with the MOEs (listed in chapter 3) to evaluate any specific wargame not listed in this chapter.

V. Wargame Evaluation

5.1 Introduction

As a result of the search procedure described earlier, eight commercial wargames were procured for evaluation. These included the board wargames *Air & Armor* by West End Games; *AirLand Battle* by Omega Games; and *Flashpoint: Golan* and *Gulf Strike* by Victory Games, Inc., along with the computer wargames *Command HQ* by Microplay; *Conflict: Korea* and *Conflict: Middle East* by Strategic Simulations, Inc. (SSI); and *Air Force Commander* by Impressions. As mentioned in the previous chapter, *Air & Armor*, *AirLand Battle*, *Flashpoint: Golan* and *Command HQ* were all quickly eliminated for various reasons, leaving only one board wargame and three computer wargames to evaluate.

5.2 Air Force Commander

Air Force Commander was published in 1992 by Impressions. It is designed to simulate air warfare in the Middle East. This wargame requires a personal computer with VGA graphics, 640K RAM, and a mouse. The wargame is designed more along the lines of an arcade game and can be played by only one person. The map scale, time scale, and unit scale are not documented in the material provided with the wargame. The best I can determine, each aircraft unit in the game represents one squadron. Each squadron is assigned from one to five aircraft for the purposes of the model, but only one aircraft from each squadron is ever in play. That aircraft flies every mission until the game ends or it is destroyed. Once destroyed, the model allows the second aircraft to be activated. This procedure repeats until all the aircraft assigned to that squadron have been destroyed, at which point all references to that unit cease to exist.

This wargame is relatively unique because it does not utilize some type of hexagonal or other grid system for determining movement. You can move about the

map by using the eight scrolling functions provided in a side menu (these allow the map to be scrolled up, down, left, right, or diagonally). You do not actually plot the movement of any individual units. Instead, when selecting any type of bombing mission, the computer program will automatically revert to the radar map (described below) and provide the player with a flashing "pipper". The player can then scroll the map until the desired target of the designated bombing mission is found. The player positions the "pipper" over the target and pushes the mouse button, or hits return, and the target is selected.

Map scale is not documented, but the game allows you to display a strategic map which encompasses the entire region from Sudan in the south to Turkey in the north. The strategic map provides only a terrain overview with no cities or military installations displayed. To get a view of the operational environment, you can select the radar map which is large enough to display an area about twice the size of Lebanon. This radar map displays airbases (represented by white dots), support structures such as food warehouses, water works, ammunition factories, power facilities, and ammunition depots, (all represented by blue dots), and military targets such as radar facilities and anti-aircraft guns (represented by orange dots). Major cities appear as green circles, but these can not be attacked. "An air unit is shown as a dotted marker, the height of which corresponds to the unit's altitude - taller markers represent planes flying at higher altitudes"[20:8]. Enemy aircraft appear as red and white striped markers, while friendly aircraft appear in different color schemes to allow the player to better track what is going on. These color schemes are:

- black and white = missile of either side
- red and yellow = interceptors
- blue and white = strike aircraft
- green and yellow = ground attack aircraft
- red and green = helicopters
- red and blue = long range bombers

blue and green = AWACS [20:8]

A third map, the satellite map, allows you to zoom in and examine these targets more closely. Each facility or unit has a distinct icon. These include airfields (complete with runways), a water works, a warehouse, power plants, etc. In addition, any aircraft unit which happens to fly through the displayed area of the satellite map will appear as an aircraft icon. Each type of aircraft has its own individual icon that resembles that particular aircraft.

Playing time depends on the scenario chosen, but more importantly on the ability of the player. A beginner could easily have his/her entire force destroyed in under fifteen minutes. There are 14 individual scenarios, but the player has the option of playing either side, so there are effectively 28 different scenarios available. Some are based on hypothetical situations, others are based on historical battles (like Desert Storm or the 1973 Arab-Israeli War). Desert Storm is one of the largest and most complicated scenarios, and can take several hours to play, while some of the smaller scenarios (for example Lebanon versus Jordan) can be played in thirty minutes or less. In the Lebanon-Jordan scenario, Jordan has a significant advantage because it has a much larger air force, so playing the Jordanian side makes this an excellent scenario for learning the game.

Documentation is very poor. The rulebook is incomplete, provides no examples, no orders of battle, and no maps. It lists the different types of mission capabilities which exist in the wargame, but does not provide any detailed information regarding which units can perform which missions or how to go about it. The game mechanics are not complex, but learning them was very frustrating due to this lack of documentation. When you select a scenario, you don't even know what forces you or your enemy have available. You don't know the location of enemy bases and other targets, or even your own. The first chance you get to examine any of these things is when you start the chosen scenario. Unfortunately, the moment you select start, your enemy begins launching attacks. All friendly units, including Surface-

to-Air Missiles (SAMs) begin the game inactive. Your first task is to activate your defenses, all the while the enemy aircraft continue toward their targets. The SAMs and mobile radars must first be transported to the operating location you desire. You are not allowed to deploy them right on the airfields where they begin so you have to select the transit command for each one and then designate where you want it to set up. It then takes an appropriate amount of time for the helicopter transport to carry the unit to that site. Once it arrives, it becomes operational. SAMs will automatically engage any target they can acquire. The player has no control over the firing of any SAM units. While the SAMs are nice to have, the main defense relies upon whatever interceptor assets you have available. These are described in more detail below.

Once you succeed in establishing some type of defense, then you can start to examine the enemy's dispositions and begin planning your own strikes. Unfortunately, due to the limited amount of territory that can be displayed at any one time, you really never get much of a chance to think. You spend any free time scanning different sections of the map looking for enemy aircraft and targets. The large scenarios, like Desert Storm are nearly impossible to play because one person simply can not keep track of so many entities on so many different map sections.

5.2.1 Aerospace Control. Aerospace control is rated R. The entire premise of this wargame is establishing air superiority. That is really the only way the game can be won, although scenarios involving U.S. forces can be lost if the war drags on for any length of time due to U.S. national resolve causing the U.S. to cease fire. Air superiority is achieved by destroying every single aircraft of the opposing side, or destroying all their airbases. Lebanon only has one airbase, so if the Jordanians can destroy it, the game will end shortly. An additional effect of destroying the last airbase is that every airborne enemy aircraft, as well as every remaining cruise missile and SAM facility, will immediately vanish the moment the base is destroyed.

This is rather unrealistic, because at the very least those aircraft should attempt to complete their assigned mission.

Different types of missions are allowed based upon the individual type of aircraft being assigned. Three of the mission options available for interceptor type aircraft are patrols, bomber escort, and interception. Patrols allow the aircraft to automatically intercept any incoming enemy aircraft they detect. Bomber escort allows the interceptor to accompany a bomber unit on a strike mission, automatically intercepting any enemy aircraft that get too close. Intercept missions allow you to designate exactly which incoming enemy unit you want intercepted. A drawback of intercept missions is that the friendly aircraft will return immediately to base after it successfully intercepts the enemy unit, totally ignoring every other enemy unit nearby. It is incumbent upon the player to "catch" the friendly interceptor as it moves across the tactical map by using the mouse to "click" on the nose of the aircraft icon (an exercise in hand-eye coordination that has nothing to do with commanding aircraft). Once the interceptor is "caught" you may freely select any new target for interception. The patrol option allows you to place interceptors in an airborne, defensive patrol. Patrolling interceptors will automatically vector toward the nearest enemy aircraft. Unfortunately, this often leads to several of your aircraft attempting to intercept the same enemy aircraft while ignoring others. It would seem logical that aircraft with an intercept mission should utilize the patrol logic to search for additional targets once they finish an intercept, prior to returning to base. This wargame plays more like an arcade game than a true wargame and does not properly model the air superiority process.

5.2.2 Strategic Attacks. Strategic attacks rate an I. Multi-role aircraft, like F-15s, can perform intercept missions, but they can also conduct bombing raids. These amount to low-level raids, armor strikes (against radars and anti-aircraft guns), or altitude drops (which are immune to anti-aircraft fire). Each aircraft has a different ability to perform each of these missions. The targets can be airfields, radars,

AA guns, or any of the blue targets mentioned earlier. Destroying the enemy's radar can blind his defenses, allowing your aircraft to penetrate to the target much easier. Destroying the AA guns eliminates ground fire against your low level bombing missions, which will result in fewer combat losses of friendly aircraft. Destroying the "blue" targets will cause increasing political unrest in the target country, but in playing the game over 100 times, I have never been able to cause this unrest to reach a level high enough to cause the enemy to surrender. One lesson I learned as the U.S. player is never to bomb a hospital because the public outcry will be so great that you will lose the game. Although strategic bombing missions are possible, they have no real impact on the outcome of the game.

5.2.3 Interdiction. Interdiction is not modeled due to the lack of ground units - N.

5.2.4 Close Air Support. Close air support is not modeled due to the lack of ground units - N.

5.2.5 Airlift. Airlift of troops is not modeled, again because no ground troops exist. A helicopter icon does appear to transport SAM units, cruise missiles, and mobile radar units about the map, but this really does not address the MOE of airlift, so a rating of N is appropriate.

5.2.6 Air Refueling. Air refueling is not modeled - N.

5.2.7 Electronic Warfare. ECM and ECCM are not modeled - N.

5.2.8 Surveillance And Reconnaissance. Surveillance and Reconnaissance - I. This wargame depends on radar coverage. In fact, until you can deploy an AWACs or mobile radar unit to enhance your radar coverage, many areas of the enemy country may appear as green flecks to simulate the lack of coverage. Once

AWACs or mobile radars are deployed, they provide the needed radar coverage and the green flecks disappear, allowing you to examine the enemy dispositions that were previously obscured. Despite this radar coverage, you still do not know what types of enemy aircraft might occupy a particular base unless you can afford the luxury of leaving the map focused on the base long enough to see what types of aircraft are taking off and landing there. Reconnaissance is not modeled. The radar coverage of the enemy territory is the only way to see what is there. The single most irritating fact about this wargame is that it allows you to deploy mobile radar installations anywhere on the map. You can place them in neutral countries, or you can deploy them to the enemy's capitol where they will never be attacked or destroyed! You can also freely violate the airspace of any neutral countries as often as you like. This is totally unrealistic and an annoying flaw in the logic. Another problem with this wargame is that as long as you have radar coverage of a target, you have perfect intelligence of its status. This includes immediate bomb damage assessment of every single attack. All you have to do is focus the satellite map on the target, for example, an airfield. You can actually watch the strike aircraft icon fly onto the screen and drop its bombs (denoted by bomb bursts on the ground) and then, simply by "clicking" the mouse over the airfield icon, you receive an immediate update regarding the damage status of that airfield. This allows you to immediately launch another strike, or if the target is destroyed (in which case the icon vanishes) and additional strike aircraft are enroute, you can abort those missions, thus saving resources.

5.2.9 Base Operability And Defense. Base operability and Defense - I. The wargame allows you to deploy SAM units in any manner you see fit, so you quickly learn to deploy them around airfields for maximum effect. Remember, if all the airfields are destroyed, then the SAMs will vanish and the game is lost. The wargame does not allow you to choose where you wish to locate an airbase, or to build an airbase. It does allow you to divert resources to repair an airbase that

has sustained battle damage, but in doing so you have to suspend all operations from that base during the repair period. One drawback of the wargame is the great lethality which cruise missiles have against airbases. Two cruise missiles will almost always destroy an airbase (on rare occasions it takes three), provided they penetrate the defenses. The wargame also greatly over-rates the ability of interceptor aircraft to shoot down Exocets and Scuds, while the Patriot batteries available in some scenarios have not yet succeeded in destroying any Scuds in the over 100 times I have played this wargame.

5.2.10 Logistics And Combat Support. Logistics and combat support are (like in all commercial wargames I have ever seen) lumped under the category of supply. The only control you have over these issues is the ability to control what units, and/or facilities you activate. Thus, if you find your supplies dwindling, you can mothball facilities and/or units that are not currently needed. For example, suppose you have lost half of your aircraft. It would be possible, and probably quite prudent, to mothball one or two of your airbases (assuming you have several) and concentrate your remaining aircraft at the active bases. This would cut down your consumption of supplies, thus prolonging the amount of time you have to win air supremacy. No documentation is available indicating the rates at which each unit or installation consumes supplies. Logistics rates an I while combat support receives an N.

5.2.11 Weather. Weather is not modeled - N.

5.2.12 Day/Night. Day/night is not modeled - N. Everything is a daytime battle.

The overall premise of *Air Force Commander* is exactly the type of wargame that could be of great use in the education process. Any game which could focus on the battle for air supremacy without including ground units has merit, provided it

addresses all the other issues in an accurate manner. Assuming the wargame covers the majority of the air war correctly, it would be easy to add restrictions on the use of certain aircraft in the order of battle to simulate their dedication to close air support missions. Unfortunately, just about every single combat process in *Air Force Commander* is grossly simplified, and the pace of the action is so intense as to make mission planning a moot point, there simply is not enough time. This wargame is not appropriate for use at the Air Force Wargaming Center.

Modification of *Air Force Commander* is not a viable option either. The documentation is so poor that you would be better off to start over. Maps of each battlefield would have to be included, as well as order of battle information. With the technology available today, nobody is going to begin a war without knowing where important military and logistics installations are located. Additionally, information regarding the size and quality of a potential enemy's military is readily available in sufficient enough accuracy to make initial planning possible. All these things would have to be added to *Air Force Commander*. The single player restriction is also a problem, although not as serious. Entire air staffs are responsible for planning air campaigns and spend countless hours doing so, based on intelligence assessments and other data. In *Air Force Commander*, one person gets a few seconds to decide what to do.

All of the programming problems previously cited would need correction. The faulty interceptor and patrol logic, which quite possibly was programmed for simplicity, would need to be corrected so that multiple friendly interceptors do not concentrate on one target while letting the rest of the enemy aircraft through unscathed. I would think a relatively simple routine could be written to have aircraft query other friendly interceptors to see what target they are chasing, thus avoiding this problem. The issue of the violation of neutral airspace may require a significant amount of additional computer code, but other computer wargames do have embedded routines that prohibit movement into neutral territory. These games flash a warning to you

that the move you are attempting is illegal and prompt you to try again. This same routine could be used to prevent the deployment of friendly radar and missile systems in enemy territory. It is my opinion that this would be worth the extra code and expense to add to this wargame. You could rely on the players integrity not to do these things, but nothing would prevent the enemy (the computer) from violating neutral airspace. If he can do it, then it is only logical that you should be able to also. That is why I feel the computer code must be corrected. The problem with perfect intelligence could also be handled with an additional routine which delays the intelligence update cycles and introduces an element of uncertainty. Again, this would require more computer code, but other computer wargames do this very thing.

These are just a few examples of potential corrections which would improve this wargame. Due to the extensive nature of the corrections, and the fact that this is really an arcade style game, it is my judgement that modification of this wargame is not practical.

Aerospace Control	R
Strategic Attacks	I
Interdiction	N
Close Air Support	N
Airlift	N
Air Refueling	N
Electronic Warfare	N
Surveillance and Reconnaissance	I
Base Operability and Defense	I
Logistics	I
Combat Support	N
Weather	N
Day/Night	N

KEY

N = Not Modeled

S = Satisfactory Model

R = Rudimentary Simulation

I = Incorrect or Inaccurate Simulation

Figure 5.1. MOE Summary for *Air Force Commander*

5.3 *Conflict: Korea*

Conflict: Korea was published in 1992 by Strategic Simulations, Inc. (SSI). It is a heterogeneous, aggregated model designed to simulate war in Korea. The wargame requires a personal computer with VGA, EGA, or CGA capability and 640K RAM. The game provides three historical scenarios between the North Korean Peoples Army (NKPA) and Chinese Communists and the Republic of Korea (ROK) with United Nations (UN) support. The first scenario is the campaign game and begins with the actual invasion of South Korea on 25 June 1950. The second addresses the UN break-out from the Pusan perimeter and begins on 15 September 1950, and the third represents the Chinese intervention and begins on 22 November 1950. The wargame also features a hypothetical 1995 war between the NKPA and ROK with U.S. assistance. Five different difficulty levels are available. Each difficulty level multiplies the combat strengths of each communist unit by either 0.8, 0.9, 1.0, 1.1, or 1.2, thus making the communist force weaker, stronger, or historically accurate.

Two different maps can be displayed. The Strategic Overview map displays the entire Korean peninsula. This provides an overview of the approximate locations of forces, but has no impact on the battle because no commands can be given to any combat units using this map. It is merely designed to give the player a feel for the overall situation. "The main map screen shows an area fourteen hexes wide and eight high (about 4% of total map area)"[18:3]. Each hexagon represents an area roughly 15 kilometers across. When playing this particular wargame in VGA mode, the hexagons do not appear on the computer screen, which makes the graphics look even nicer without causing any problems in moving units. When played in CGA mode the hexes do appear.

One gameturn represents one week of actual time. Ground units begin as individual regiments, brigades, or battalions (depends on the unit and nationality). These basic units may be combined into larger combat units with the option of renaming each composite unit as it is created. Certain restrictions are placed upon

this combination process. No more than six units may be combined, only four of which can be infantry. The remainder of the restrictions primarily deal with nationalities, i.e. no U.S. units may combine with ROK units, no Chinese units with NKPA, etc.

Air units do not actually appear on the gamemap. A separate screen contains all the information about air units. For the historical scenarios, the North Koreans do not even have an air force, so the only air units that appear are U.S. Air Force Wings and Groups, U.S. and British Carrier Air Groups (CAG), and U.S. Marine Air Groups. Each wing or group is assigned an aggregated AA (air-to-air) rating and AG (air-to-ground) rating. The hypothetical scenario does provide a small air force to the NKPA player consisting of one bomber division, five fighter divisions, and seven fighter regiments, but even if deployed as optimally as possible, it will only last a few turns before the ROK and U.S. air units destroy it. Once again, each air unit has an aggregated AA and AG value. Appendix H of the rulebook provides information on the makeup of individual air units. "In some cases, these units represent average strengths as individual squadrons were rotated in and out of theater during the campaign"[18:55]. The following represent a sample of the data listed in appendix H and provides an illustration of the composition of some of the air units in the wargame.

For the historical scenarios:
8th Fighter Bomber Group (prior to July 1950) - 100 Shooting Star,
Twin Mustang
3rd Bomb Wing (Light) - 45 Invader
19th Bomb Group - 25 Superfortress
Carrier Air Group 5 (USS Valley Forge) - 30 Panther, 30 Corsair, 15
Skyraider
33rd Marine Air Group - 30 Corsair, sometimes 15 additional Tiger-
cat, Corsair.
Carrier Air Group Theseus (HMS Theseus) - 15 Sea Fury, 15 Firefly
27th Fighter Escort Group - 75 Thunderjet
4th Fighter Interceptor Group - 50 Sabre

For the hypothetical scenario, the following are typical:
NKPA 1st Bomber Division - 80 H-5 (Chinese version of IL-28)
NKPA 1st Fighter Division - 75 J-5 (Chinese version of MiG-17)
NKPA 16th Fighter Regiment - 40 J-7/MiG-21
NKPA 22nd Fighter Regiment - 30 MiG-29
ROK 1st TFW - 48 F-16
ROK 7th TFW - 40 F-4
USAF 314th Air Division - 72 F-16
USAF 313th TFW - 72 F-15
US 1st Marine Air Wing - 72 F-18, Harrier
USN CAG Vinson - 58 F-14, F-18, A-6
USAF 9200 Prov Bomb Wing - 48 B-52

Each of the listed units is represented in the wargame by a single unit capable of performing a single mission each turn.

One additional point concerning the 1995 scenario is the failure to include the Japanese Air Force. Col Trevor N. Dupuy, U.S. Army (Ret.) points out in his latest book *Future Wars* that "A Communist victory there would have unquestionably had adverse effects in Japan, for there were growing economic ties between the Republic of Korea and its former colonial rulers"[9:189]. Dupuy goes on to say "The Japanese air force (ASDF), 46,000 strong with its main strength lying in its 135 F-15 and 74 F-4E fighters, was best placed to play an active role in support of South Korea"[9:189]. Dupuy further emphasizes the importance and proximity of the ROK to Japan as strong reasons why Japan would intervene in any war on the Korea peninsula.

The documentation for this wargame was excellent. The rules were clearly written and quite complete. They included a copy of the gamemap for both the historical and hypothetical scenarios. They also contained the complete order of battle for both sides, as well as a reinforcement schedule for all four scenarios. These orders of battle also contained the combat values of all the units, making it possible to actually plan operations. Appendix F, titled Formulae included details on the program logic for determining aircraft basing, airfield status, unit strengths, combat loss ratio calculations, 1995 scenario air superiority calculations, movement sequence,

and overrun calculations. This made it much easier to understand why things were happening during the play of the wargame.

Playing time depended on the scenario, ranging from six to eight hours for the short scenarios against the computer, to over twenty for the complete campaign game. You have the option of playing either side against the computer, or two people can play each other, sharing one computer. If this option is selected, then double the above playing times because the process of making a move can take fifteen minutes or longer, but the computer does it in fifteen seconds or less.

5.3.1 Aerospace Control. Aerospace control - R. The historical scenarios automatically assume the UN forces will have total air control.

On the 25-June-1950 turn, the United Nations air force is automatically allocated to destroying the North Korean air force. For the remainder of the war, Communist air forces will operate from bases in China and the Soviet Union.

Communist air forces are represented abstractly as a Communist Interception Level (CIL)[18:16].

The communists begin the campaign scenario with five CIL factors. They receive no more until the 1 Sept 1950 gameturn, at which time they begin to receive 10 additional CIL factors per turn. Beginning 1 Jan 1951, this CIL factor increases by 15 per turn. These CIL factors will only affect UN interdiction missions or UN ground strike missions delivered in MIG Alley (essentially, the northwestern corner of North Korea). These factors can be destroyed permanently by UN aircraft with an air superiority mission. For every five AA factors assigned to an air superiority mission, one CIL factor vanishes from play. The CIL factors are not capable of destroying any UN air units. All they can do is degrade the effects of the interdiction or close air support missions. Although this is a limitation in the sense that the wargame does not explore the struggle for aerospace control, it is a pretty fair simulation

of what happened historically. The book *Air War Over Korea* by Robert Jackson emphasizes the air capability of North Korea.

On June 25th, 1950, the North Korean Air Force possessed a total of 132 combat aircraft, comprising 62 Ilyushin Il-10 ground attack machines, and 70 Yak-3, Yak-7B, Yak-9, and La-7 fighters. There were also 22 Yak-18 twin-engined light transports, and 8 Polikarpov Po-2 trainer aircraft. The majority of the combat types were concentrated on two principle airfields at Pyongyang and Yonpo, but by the time the war broke out several flights had moved forward to hurriedly prepared advance bases near the 38th Parallel[17:13-14].

The book goes on to describe the use of airpower by both sides in the first few weeks of the conflict. The Communists were, on rare occasions, able to slip a few aircraft through the U.S. defenses to strafe airfields, but only succeeded in destroying a few aircraft (mostly transports) on the ground. The net contribution of the North Korean Air Force had little impact on the actual outcome of the battle.

When the UN player assigns a unit to an air superiority role, he does not choose what base to attack, where to conduct fighter sweeps, or anything else. The computer totals all AA factors assigned to air superiority for a given turn, divides that total by five, rounds off to the next lower whole number in case of fractions, and then deducts that number of CIL points from the communist total. In the hypothetical game, the players only control of air superiority is in the units they select for that role. You do not determine if you want to conduct fighter sweeps, bomb enemy airbases, or simply adopt a defensive posture. The computer does all that for you and calculates the results based on the following formula.

Air superiority = sum of air to air strengths for all friendly air units with air superiority missions + 20% of the sum of air to air strengths for all friendly air units with other missions.

A loss ratio is calculated for each player as follows: Loss ratio = 10% * (enemy air superiority strength) / friendly air superiority strength. Loss ratios are limited to a maximum of 90%.

Each air unit will lose a portion of its air to air and air to ground strengths equal to that player's loss ratio. If both strengths of an air unit are reduced to zero, the unit will be removed from the game[18:52].

While all these equations are consistent with an aggregated approach to modeling, the air superiority aspect of this game is much too simplistic to be of any value as an educational tool and therefore the aerospace control MOE rates a R.

5.3.2 Strategic Attacks. Strategic attacks are not modeled and therefore rate an N.

5.3.3 Interdiction. Interdiction missions are possible for both sides in the hypothetical scenario, and play an important role in the historical scenarios. You simply select the interdiction option for any and all air units that you wish to assign to that role during a given turn. During the combat resolution process, the computer totals the interdiction level and then selects a random number between zero and that total. This is the amount by which the enemy stockpile is reduced for that turn. The interdiction value also affects the re-supply of enemy units later that turn. Interdiction missions are especially effective versus communist units in South Korea during the historical scenarios.

The farther one side penetrates into the other side's territory, the longer the supply lines become, and the more susceptible that side's units are to the effects of interdiction. The wargame shows these effects quite clearly through the reduced states of readiness and loss of combat power of units the farther they penetrate. Unfortunately, the only control you have over interdiction is through selecting that option. You are not asked to decide what road nets or rail nets to bomb. You never see the effects of bombing bridges and tunnels and how that restricts the flow of supplies. All you see is this "magical" thing called interdiction causing enemy units to get weaker and weaker. Once again, the wargame simply does not provide the

type of education value the Air Force Wargaming Center is looking for, therefore I rate interdiction an I.

5.3.4 Close Air Support. Close air support is without a doubt the one aspect of aerospace power that this wargame does fairly well. For every unit you assign to a close air support mission, you are given one airstrike prior to the ground combat resolution process. The power of that air strike depends on the AG value of the unit and the weather. The computer will prompt you with the number of air strikes available, which air unit is the next to be used, and what its lethality percentage for that turn is. You can then move the cursor around the map and place it over the enemy unit/s you wish to bomb (up to two units may be in the same hex). The computer then calculates the effect of the attack, factoring in the type of defensive posture the enemy unit is in (example - an enemy unit in the mountains is much better protected than one in clear terrain). Since the UN player has so many air units in play by the end of July, these close air support missions can literally break the back of the NKPA assault. In the hypothetical scenario, the ground units do have a limited SAM capability and occasionally will inflict damage on the attacking aircraft, but in the historical scenarios ground fire is nonexistent. Airstrikes by themselves are not capable of totally destroying an enemy ground unit. This MOE receives an S.

5.3.5 Airlift. The UN player has one airborne unit which can move by air in the historical scenarios. Other than that, no airborne operations are possible. Additionally, UN units have a very limited ability to receive supply by air providing the weather for that turn is not "storm". The player has absolutely no control over this supply procedure, it is entirely a random event calculated by the computer. Therefore, this MOE receives an R.

5.3.6 Air Refueling. Air refueling is not modeled - N.

5.3.7 Electronic Warfare. Electronic warfare is not modeled - N.

5.3.8 Surveillance And Reconnaissance. Surveillance and Reconnaissance is not modeled in the sense that neither side has control over any assets for performing these missions. The wargame does offer an option to play with complete intelligence or limited intelligence (the computer player always plays with limited intelligence). Complete intelligence will automatically always display every enemy unit, no matter where it is on the mapboard. It also allows you to discover the exact combat value of any unit you choose to examine more closely. It does not provide any information about the opposing air forces however. Limited intelligence will only display an enemy unit if it is adjacent to a friendly unit, or if the aerial reconnaissance function (a totally random process over which the players have no control) discovered it. Limited intelligence does not allow examination of the combat values of any discovered unit. This adds a great deal of uncertainty to the battle and a great deal more realism. I rate the MOE an R because the player has no control over the intelligence gathering functions, but acknowledge that the limited intelligence option provides additional realism when playing the game.

5.3.9 Base Operability And Defense. Base operability and defense is poorly modeled, with ground attack being the only way to damage or destroy an air base. Historically this is probably acceptable since the North Koreans did not possess the necessary airpower to conduct base attacks[17:9-31]. The UN forces were constrained politically from attacking the communist airbases in China and the Soviet Union. However, for the purposes of the 1995 scenario, airbase attack should be included and therefore I rate this MOE as N.

5.3.10 Logistics And Combat Support. This wargame lumps logistics and combat support into one and calls it supply. The only control the players have over supply is through the use of interdiction, and the use of sea-lift (UN only), airlift

(UN only), and railroads. An option exists to move some combat units by rail, sea, or air, subject to the limitations I have already mentioned. However, for every unit moved by any of the above methods, that side loses a portion of its supply capacity for that turn since the transports are carrying troops and not supplies. That is the summation of the control you have over your supply situation. For this reason, the logistics MOE gets an R, the combat support MOE gets an N.

5.3.11 Weather. Weather is included in this wargame. The weather can be either Fair, Cloudy, or Storms. Weather affects ground unit combat and movement, and Storms prevent any naval missions. I will focus on the effects of weather on air operations. Fair weather has no effect, all units attack at 100% effectiveness. Cloudy weather is considered "poor" for air operations, and Storms are considered "lousy" for air operations. They have the following effects on the combat capability of the various types of air units in this game:

Long Range/All Weather units (operating from any base) - 100% in cloudy weather, 50% during storms.

Long Range units (operating from any base) - 50% in cloudy weather, 33% in storms.

Short Range/All Weather Units - 100% in cloudy weather, 50% in storms.

Short Range units (based in Japan) - 50% in clear weather, 33% in cloudy weather, 25% in storms.

Short Range units (based in Korea or on carriers) - 50% in cloudy weather, 33% in storms[18:8].

The computer simply multiplies the AA or AG value of the individual unit by the appropriate percentage during the combat calculations. This allows the wargame to demonstrate the effect weather can have on a battle. However, one possible criticism is that the weather for a given turn represents an entire week so some of the impact is abstracted. The author makes the assumption that during a one week time period, the weather will have the average effects represented by the above percentages on

airpower. For the scale of this wargame, I find nothing wrong with the manner in which weather is modeled. I assess this MOE as an S.

5.3.12 Day/Night. Day/night is not modeled - N.

Conflict: *Korea* is a very enjoyable and challenging wargame covering the historical Korean war and including a hypothetical future scenario. Unfortunately, it only addresses two of our desired MOEs in a satisfactory manner and is therefore not suitable for use by the Air Force Wargaming Center. Additionally, the planning and employment of airpower makes up a very small percentage of each game turn. The game is really only suitable for play by two players, and if playing a historical scenario, only the UN player would have an air force to employ. The lack of adequate coverage of the desired MOEs makes modification of this wargame unreasonable. Complete sets of computer code would be required to account for the simulation of the missing MOEs and extensive rewrites would be required to modify the unsuitable ones. It is therefore my opinion that modification of this wargame would not be feasible.

Aerospace Control	R
Strategic Attacks	N
Interdiction	I
Close Air Support	S
Airlift	R
Air Refueling	N
Electronic Warfare	N
Surveillance and Reconnaissance	R
Base Operability and Defense	N
Logistics	R
Combat Support	N
Weather	S
Day/Night	N

KEY

N = Not Modeled

S = Satisfactory Model

R = Rudimentary Simulation

I = Incorrect or Inaccurate Simulation

Figure 5.2. MOE Summary for *Conflict: Korea*

5.4 *Conflict: Middle East*

Conflict: Middle East was published in 1991 by Strategic Simulations, Inc. (SSI) and authored by Norm Koger, the same author as *Conflict: Korea*. The reader will note many similarities between the two wargames. *Conflict: Middle East* is a heterogeneous, aggregated model designed to simulate war in the Middle East. It requires a personal computer with EGA, or CGA capability and 512K RAM. The game provides one historical scenario representing the 1973 Arab-Israeli War and a hypothetical 1990's Arab-Israeli conflict. The principle forces in the historical scenario are Israel, Egypt, Syria, and if conditions are right, Jordan. Additionally, a number of other Arab countries provide anywhere from one to a half dozen combat units on the Arab side. Five different difficulty levels are available. Each difficulty level multiplies the combat strengths of each Arab unit by either 0.8, 0.9, 1.0, 1.1, or 1.2, thus making the Arab force weaker, stronger, or historically accurate.

Two different maps can be displayed. The Strategic Overview ". . . map shows the Middle East from Cairo in the west to Damascus in the east, and from the Golan Heights in the north to the tip of the Gulf of Suez in the south"[19:4]. This provides an overview of the approximate locations of forces, but has no impact on the battle because no commands can be given to any combat units using this map. It is merely designed to give the player a feel for the overall situation. "The main map screen shows an area fourteen hexes wide and eight high (about 6% of total map area)"[19:4]. Each hexagon represents 10 kilometers of real terrain.

One gameturn represents twelve hours of actual time. Ground units begin as individual companies, brigades, or battalions (depends on the unit and nationality). Only the Israeli player is allowed to combine or restructure combat units, in any manner deemed necessary. This allows the creation of "super units" which the Arab player will have great difficulty defeating. Each unit carries attributes which keep track of the exact number and types of weapons assigned to the unit (for example - 15 M-113s, 27 Centurians, 5 81mm mortars, 35 infantry squads, etc.) The upper

limit is 255 of any one type of weapon or infantry squad, with up to 8 different types in any single unit. New units can be created and can be as small as an individual tank. The one restriction is that no more than 112 Israeli ground units can be in play at any point in time. This is a computer programming limitation and not a reflection of any type of historical organizational doctrine. The Arab player is not allowed to alter the composition of any of his units in any manner. Since only two units can be stacked in any one hex, this makes it difficult for the individual Arab units to stand up to their Israeli counterparts.

Air units do not actually appear on the gamemap. A separate screen contains all the information on air units. Each type of aircraft available in a particular scenario is grouped together. In cases where certain aircraft have virtually identical capabilities, two or more types can be totalled into one group (for example, in the historical scenario there is no distinction between the Arab MiG-21s and Mirage IIIs). The total number of each type (or in some cases types) of aircraft is listed along with the combat capabilities of that group. These include an Air Superiority rating, a Strike/Interception rating, a Close Air Support rating, an Avionics rating, and a Survivability rating. Each of these values range from 0 to 4 and impact that aircraft's ability to perform certain missions. The following tables are provided as examples of the starting air force capabilities of each side for the 1973 scenario.

AIRCRAFT	Initial number	Air Superiority	Strike/Interdiction	Close Air Support	Avionics	Survivability	TYPE
MiG-17	195	1	1	1	1	1	fighter
MiG-21, Mirage III	490	2	1	1	2	2	fighter
Hunter	0	1	2	2	1	1	bomber
Su-7	130	0	2	1	1	1	bomber
Tu-16	25	0	4	0	2	0	bomber

Figure 5.3. 1973 Scenario Initial Arab Air Force

AIRCRAFT	Initial number	Air Superiority	Strike/Interdiction	Close Air Support	Avionics	Survivability	TYPE
Super Mystere	18	1	2	2	1	2	bomber
Mirage III, Kfir	79	2	1	1	2	3	fighter
F-4	121	3	3	3	3	4	fighter
A-4	162	1	2	2	1	2	bomber

Figure 5.4. 1973 Scenario Initial Israeli Air Force

For example, an Air Superiority rating of 0 would prohibit that type of aircraft from performing an Air Superiority mission, while a rating of four would indicate an excellent Air Superiority aircraft. Obviously, the higher the rating, the better that aircraft is in that particular role. This can pose some interesting dilemmas for the player when it comes time to assign air missions for a given turn. These effects will be discussed in more detail under each of the appropriate MOEs. The wargame

does multiply all Israeli aircraft by four when making combat resolution calculations in order to account for the qualitative advantage of the Israeli Air Force. Despite being outnumbered 840 to 380 total aircraft at the start of the historical scenario, and 1262 to 709 in the hypothetical scenario, the combination of the better quality of their aircraft coupled with pilot quality causes them little difficulty in establishing air superiority.

The documentation for this wargame was excellent. The rules were clearly written and quite complete. They included a copy of the gamemap as well as the complete order of battle for both sides including the reinforcement schedule for both scenarios. These orders of battle also contained the combat values of all the units making the planning of operations possible. Appendix F, titled Formulae included details on the program logic for determining air superiority, other air mission types, anti-air calculations for each target type, unit strengths, combat loss ratio calculations, and overrun calculations. Just like *Conflict: Korea* this made it much easier to understand why things were happening during the play of the wargame.

Playing time can range from ten to twenty hours for either scenario against the computer, depending upon the difficulty level chosen. You may play either side against the computer, or two people can play each other, sharing one computer. If this option is selected, then double the above playing times because the process of making a move can take fifteen minutes or longer, but the computer does it in fifteen seconds or less.

5.4.1 Aerospace Control. Aerospace control rates an I. *Conflict: Middle East* provides a better simulation of the battle for air superiority than *Conflict: Korea*. This is partly due to the fact that both sides have a significant air force in both scenarios. The major disadvantage for the Arab player is the limited ability of his air force in other than perfect weather (more on that later). Another disadvantage, just like in *Conflict: Korea*, is that when the player decides to assign aircraft to a

certain mission (such as air superiority), the computer actually employs the assets. In other words, the player may select an air superiority mission, but has no control over how that mission is performed. This is also true for most of the other mission options. One positive point is that this wargame allows the player more control over how aircraft are assigned missions than *Conflict: Korea*. The player simply selects the type of aircraft desired, then can assign them in increments (which are dependent on the type of aircraft, the mission, and the weather) to a particular mission. Thus, if 18 Super Mystere are available to the Israeli player, three could be assigned interdiction missions, 3 ground strike missions, and the other 12 to air superiority. This alleviates the *Conflict: Korea* restriction that all aircraft of a given unit must be assigned the same mission. On the negative side is the fact that neither the aircraft or their bases appear on the map. This is particularly distressing where the Arab aircraft are concerned because there is simply no way to tell which country the aircraft belong to, or where they are based. This is unrealistic because aircraft based in Damascus are not likely to fly ground support missions near Cairo, yet the wargame allows this with absolutely no adverse effects.

Air superiority attrition is calculated as follows:

The anti-air strength for each type of aircraft is (the number of aircraft assigned) * (air superiority value) * (aircraft effectiveness as determined by weather and avionics values) * (force readiness).

The values for all aircraft are added together and divided by 10 to calculate total base anti-air values. Israeli base anti-air strength is multiplied by four. Arab base anti-air strength is multiplied by two if Arab Competence is set to Hairy or Hideous[19:40].

"Hairy" corresponds to the 1.1 force multiplier and "Hideous" to the 1.2 force multiplier mentioned earlier. The above calculation has a SAM value added to it to arrive at the final air superiority calculation for any given turn. For the aggregated level at which this game is designed, these combat results calculations are appropriate. The wargame thus provides a feel for the importance of air superiority because the player

who allocates the entire air force to bombing type missions will suffer significant aircraft losses if the opposing fighter assets have been allocated to air superiority missions.

In addition to air superiority missions, a player is given the option of sending each strike package of close air support aircraft against either airbases, SAMs, or enemy troops. In this wargame, bombing missions against SAMs will have a direct effect on the battle for air supremacy because each strike will destroy some arbitrary number of enemy SAM assets. The resulting reduction in enemy SAMs will decrease the SAM value which is added into the corresponding air superiority calculation each turn. The drawback is that the player has no control over which SAM sites are bombed. This function is totally controlled by the computer. Thus, even though you may be planning to strike enemy troops on or near a fixed SAM site, the computer does not allow you to specify that SAM site as your target. This contradicts reality, because normally you would try to destroy, or at least suppress, that SAM site prior to attacking the nearby troops.

Strikes against airbases are also possible, but two major drawbacks exist. First, you can not select which airbase you want to attack, therefore you have no control over the types of enemy aircraft you can attack. This makes it impossible to target the aircraft which you may consider the largest threat. The computer randomly selects which aircraft are the target of each attack, but the most numerous types of enemy aircraft have a proportionally greater chance of being targeted.

The second drawback is the attrition process itself.

The readiness of the type attacked will be decreased by $(\text{strike lethality} * 30) / (\text{total number of aircraft in target force})$. Each point of lethality in the strike has a 10% chance of destroying an enemy aircraft of the selected target type. Aircraft listed as hit by the strike are not necessarily destroyed, although the force readiness for that type of aircraft will reflect damage inflicted by the strike[19:40-41].

As an example, assume 7 Israeli F-4s attack an airbase in perfect weather and all survive the anti-aircraft fire. If the computer selects MiG-17s as the target, and assuming 200 are currently available, then the calculations are $(44\% * 30)/200 = 6.6\%$ readiness reduction. Additionally, $44 * 10\% = 4.4$ aircraft hit. $4.4 * (1/6) = .733$ aircraft destroyed, which rounds off to zero. Thus the major effect of airbase attacks is the lowering of the enemy's aircraft readiness levels. Once that level reaches 50% or lower, that type of aircraft may not fly any air missions until the readiness level rises above that magic 50% figure. The wargame will not allow the readiness level of any type of aircraft to fall below 10%. The aircraft regain readiness levels at a specified rate per turn ranging from 0% to 15%, depending on the amount of territory controlled for the Israelis, or ranging from 6% to 10% depending on the competence level chosen for the Arab. The readiness level of one type (for example MiG-17s) has absolutely no effect on any of the other aircraft types in the game. Since the computer selects the targets based upon the number of each type available, it will attack the more numerous type much more frequently. This results in wasted assets. For example, if the MiG-17s have been reduced to that 10% readiness level, then further strikes can achieve no additional damage. However, I have watched in frustration as the computer continues to bomb MiG-17s while completely ignoring nearly undamaged Tu-16s and Hunters since they comprise such a small percentage of the total force.

Conflict: Middle East models air superiority using aggregated methods which are consistent with the remainder of the wargame, however the limitations I have already cited make the game inappropriate for teaching the employment of aircraft in an air superiority role to senior military leaders, therefore I rate aerospace control an I.

5.4.2 Strategic Attacks. Strategic Attacks are not modeled and therefore rate an N.

5.4.3 Interdiction. Interdiction - I. Interdiction missions are possible, but function almost identically to *Conflict: Korea*. Again, aircraft assigned an interdiction mission will degrade the enemy's ability to re-supply. Interdiction missions are particularly successful against units which have crossed the Suez Canal because all supplies have to cross bridges, which are ideal interdiction targets. Interdiction has little effect in Syria, Jordan, or Israel and overall, interdiction plays a much smaller role in *Conflict: Middle East* than it does in *Conflict: Korea*. The major drawback is once again the fact that the computer does all the interdiction targeting and calculations internally. The player is given no control over the manner in which the interdiction campaign is prosecuted, therefore, very little about the mechanics of interdiction can be learned from the game. Again, this is an aggregated model using an aggregated process to compute interdiction and as such denies the player the benefit of seeing the effectiveness of various types of interdiction attacks. Interdiction rates an I.

5.4.4 Close Air Support. Close air support is very well modeled. You can manually control both offensive and defensive close air support missions by assigning aircraft to "strike" missions, or you can assign them to "close air support" missions in which case the close air support value will be added directly to all combats involving friendly ground units during that turn. Strike missions work exactly like those in *Conflict: Korea*. The computer calculates the number of strike missions available for the turn based upon the weather and the number of aircraft assigned. It then prompts you to select the type of strike you wish to make (airbases, SAMs, ground troops), and provides you with the number of remaining strikes, the current type of aircraft striking, and the lethality of that strike. If you select ground troops, then the computer prompts you to select a target. This is accomplished by moving the cursor around the map until it is over the enemy unit you wish to bomb. The computer then calculates the effect of the attack and evaluates enemy anti-aircraft fire to determine friendly aircraft losses. Unlike *Conflict: Korea*, it is possible to destroy

any type of ground unit exclusively through air attacks. The number of attacks required depends on the type of unit, the strength of the unit when the bombing started, and its defensive posture. Artillery units are particularly susceptible to aerial elimination. This MOE receives an S.

5.4.5 Airlift. Both sides have airmobile units which can be utilized. These airmobile units move by helicopter. Only one Arab and one Israeli unit can utilize air movement per turn to simulate the limited number of helicopter assets available to each side. When using air movement, each unit is given a movement allowance of twelve hexes. Units may not over-fly enemy units using air movement. The wargame also contains a formula which addresses losses due to enemy anti-aircraft fire. It is possible for 25% to 75% of the unit's combat capability to be lost to anti-aircraft fire. In addition, it is possible that the helicopter transport capability can be lost for the remainder of the scenario if the transport helicopters get shot down. No other air transport capability is modeled, including re-supply. This MOE receives an R.

5.4.6 Air Refueling. Air refueling is not modeled - N.

5.4.7 Electronic Warfare. Electronic warfare is not modeled - N.

5.4.8 Surveillance And Reconnaissance. Surveillance and reconnaissance is modeled differently in this wargame than in *Conflict: Korea*. Neither side has individual intelligence assets which can be assigned missions (like reconnaissance aircraft or AWACS). The wargame does offer an option to play with complete intelligence or limited intelligence (the computer player always plays with limited intelligence). When playing with complete intelligence, all ground combat unit icons will always appear on the map, but that is about the only information available. When playing with limited intelligence, unit icons will only appear if they have been "spotted". The computer does not reveal the strength of that unit, so you really do not know what you are attacking (except on the first turn). This can lead to the total elimi-

nation of the attacking force if you stumble into a particularly large defending force. A "Strategic Report" screen may be displayed at any time. This screen contains a great deal of information, including a listing of the number of tanks, artillery, fighters, bombers, and SAMs available to each side but nothing about individual units. When playing with the complete intelligence option, this screen will display exactly how many of each of the above items are still available. When playing the limited intelligence option, this screen displays an estimate of the remaining number of assets and can be in error by as much as 20%. The bottom line is that the wargame allows complete intelligence regarding the location of enemy units, but the actual strength of those units is never made known, unless of course they are eliminated in combat. The wargame does not allow senior military leaders the opportunity to learn how to properly employ or utilize intelligence assets and therefore this MOE receives an R.

5.4.9 *Base Operability And Defense.* Base operability and defense is not modeled - N.

5.4.10 *Logistics And Combat Support.* This wargame lumps logistics and combat support into one and calls it supply. The only control the players have over supply is through the use of interdiction (very limited), or by physically isolating enemy units from their supply source using friendly ground units. The consequences of lack of supply can immobilize enemy units and reduce their combat values, making them much less of a threat. Units can not be eliminated just by cutting off their supply. They still have to be destroyed by friendly air and/or ground units. The wargame does illustrate the importance of supply in allowing a unit to maintain combat effectiveness, however the abstracted portrayal does not illustrate the issues that would normally concern a senior military commander. Logistics rates an R, while combat support rates an N.

5.4.11 *Weather.* Weather is included in this wargame. The weather can be either Fair, Cloudy, or Storms. Weather has significant effects on chemical weapons and air operations.

At the top of the Air Operations screen is a flight conditions indicator. Aircraft effectiveness for each condition is as follows:

Very Good 100%

Good 20% * Avionics

Poor 15% * Avionics

Very Poor 10% * Avionics

This is essentially a force multiplier[19:8].

As an illustration, suppose 20 Tu-16 aircraft are assigned a Strike mission during a turn with good weather. The avionics of a Tu-16 is 2, so $20 * .2 * 2 = 8$, or the 20 Tu-16s under these conditions will be equivalent to 8 Tu-16s under perfect weather conditions. The poor avionics capability of the 1973 scenario Arab aircraft make them almost useless except under very good flight conditions.

Flight conditions are based on weather and time of day as follows:

Fair Weather/AM - Very Good

Fair Weather/PM - Good

Cloudy Weather/AM - Good

Cloudy Weather/PM - Poor

Storms/AM - Poor

Storms/PM - Very Poor[19:8]

The wargame does a satisfactory job of modeling the effects of weather and this MOE is therefore assigned a rating of S.

5.4.12 *Day/Night.* The effects of day/night are not directly addressed in the documentation of this wargame, but the game does account for some of these effects indirectly. The distinction in the type of flight conditions illustrated previously indicates that the author was attributing reduced visibility to the PM game turns. It could logically be assumed that some portion (if not all) of the degrade

between AM and PM gameturns is being attributed to night. Additionally, ground unit movement costs are increased by one during all PM game turns, again possibly due to the reduced visibility of night. Otherwise, there is no distinction for night, and no reference to it in the rules. This MOE is rated I.

Conflict: Middle East is a very enjoyable and challenging wargame covering the 1973 Arab-Israeli war and a hypothetical future scenario. Unfortunately, it only addresses two of our desired MOEs in a satisfactory manner and is therefore not suitable for use by the Air Force Wargaming Center. Additionally, it is really only suitable for play by two persons, further limiting the educational value for an air staff. This lack of adequate coverage of the desired MOEs makes modification of this wargame unreasonable. Complete sets of computer code would be required to account for the simulation of the missing MOEs and extensive rewrites would be required to modify the unsuitable ones. It is therefore my opinion that modification of this wargame would not be cost effective.

Aerospace Control	I
Strategic Attacks	N
Interdiction	I
Close Air Support	S
Airlift	R
Air Refueling	N
Electronic Warfare	N
Surveillance and Reconnaissance	R
Base Operability and Defense	N
Logistics	R
Combat Support	N
Weather	S
Day/Night	I

KEY

N = Not Modeled

S = Satisfactory Model

R = Rudimentary Simulation

I = Incorrect or Inaccurate Simulation

Figure 5.5. MOE Summary for *Conflict: Middle East*

5.5 *Gulf Strike*

Gulf Strike is a board wargame which was originally published in 1983 by Victory Games, Inc. It is a homogeneous, aggregated model designed to simulate war in the Middle East. The wargame requires a playing area large enough to accommodate the five mapsheet sections and 1430 unit and informational counters. An 8 foot by 4 foot table is sufficient, but is slightly crowded. An 8 foot by 4 foot sheet of Plexiglass is also recommended. This can be laid over the paper mapsheets, which not only helps keep the maps properly aligned, but protects them from damage, and allows game information to be written directly on the map by using any water soluble marker. This can be especially handy for bookkeeping purposes during play. The 1983 version of the game was designed to model hypothetical engagements between U.S. and Soviet forces in the Persian Gulf. The major focus of the gameboards is Iran, but the map areas include major portions of Iraq, as well as portions of Saudi Arabia, the United Arab Emirates, Oman, Pakistan, Qatar, Bahrain, and Kuwait. This version provides a historical scenario featuring the Iran-Iraq war, and three hypothetical scenarios involving Iran, the U.S. and the Soviets. The Second Edition was released in 1988 and included new combat units to reflect the ever evolving weaponry, and a new scenario which focuses on the battle to keep the oil flowing from the gulf to the rest of the world. Again, this scenario primarily features Iran, Iraq, the U.S. and the Soviets. The final edition was published in late 1990 in response to Desert Shield. This version added additional combat units to reflect the forces of the various coalition countries as well as to reflect improvements to the Iraqi military. Since Desert Storm had not yet begun, the orders of battle for the Desert Shield scenario were based upon the author's prediction of what each side would have.

The wargame includes two different scale maps. The Strategic map encompasses the entire Persian Gulf. It extends from Mozambique and Madagascar in the south to the Black Sea and southern portion of the Soviet Union in the north. It

includes portions of Egypt and Syria in the east all the way to, and including all of, India in the west. The mapsheet is 16 inches by 22 inches, and each hexagon represents 280 kilometers of actual terrain. Aerial and naval combat is possible on this map, but the main function is to model the arrival of reinforcements to the Persian Gulf region and the potential naval battles over the Straits of Hormoz. A second map provides the operational level area where the great majority of the combat will occur. The operational map represents about 70 hexes of the strategic map centered on Iran and features the countries mentioned in the previous paragraph. One hex represents 28 kilometers, hence air and naval units can move ten times as many hexes on the operational map as they can on the strategic map. Ground units can only move one hex per turn on the strategic map, but they each have actual movement allowances on the operational map. The unique feature about this two map system is the ability of the wargame to address strategic level issues like supply lines and reinforcements and at the same time resolve combat on an operational level.

One gameturn represents two days of actual time. The wargame contains combat units and support units. The combat units include the actual ground, naval and air units. Ground units appear as individual brigades, battalions, or divisions. Naval units represent "several" ships of the designated type, or in the case of aircraft carriers, the ship counters represent the carrier battle group. Aircraft units represent from 10 to 24 individual aircraft of that particular type. Support counters such as artillery, anti-aircraft units, supply counters, airbase counters, and truck counters are also included. Trucks play an important role in this wargame because of their ability to increase the movement capability of infantry, and because they can transport supply and airbase counters to needed locations during the course of play.

Each combat unit has a series of combat values contained on the unit counter. These values include the units: movement allowance, attack strength, defense strength, and anti-aircraft strength for ground units and the movement allowance, bombardment strength, anti-aircraft strength, Anti-Submarine Warfare (ASW) strength,

Anti-Ship Missile (ASM) strength, hit capacity, and electronic warfare value (ECM) for ships and aircraft. Each airbase counter must be placed upon an airfield hex on the operational or strategic mapsheets. No more than three individual aircraft counters may ever operate from any airbase, and then only if the airbase is in supply. This causes the Iraqi player a great deal of difficulty in the Desert Shield scenario because Iraq only has six airbase counters, therefore only 18 Iraqi aircraft units can ever be in operation on any given turn. The article *Desert Storm Mother of All Battles* printed in *Command Magazine* indicates there were 18 Iraqi airbases during Desert Storm[12:16]. It appears that more airbases should be provided to the Iraqi player for this scenario. More on airbases later.

Air Unit			Naval Unit		
Bombardment Rating	4	5	ECM Rating	3	6
Anti-Air Rating	6	●	Sub-Surface Rating	8	2
Anti-Ship Missile Rating	●	4	Hit Capacity	9	5
Movement Point Allowance			Movement Point Allowance		

● = Zero Capability

Figure 5.6. *Gulf Strike* Unit Counters

The documentation for this wargame was satisfactory. The basic rulebook is 60 pages long including the scenarios. A sixteen page insert contains examples of play and all the different tables you need to play the game except for the combat results table which is printed on the operational map. The Second Edition rules add an additional 16 pages which cover new units and capabilities as well as the new scenario. The Desert Shield rules add the final 12 pages, including the scenarios and rules governing new units. Despite the large amount of rules, most of the combat and movement mechanics are relatively simple to master and use. The rules are designed to keep the complex nature of the various combat units as simplistic

as possible. Of particular value were the numerous examples contained within the insert that demonstrated the various processes, however I believe the ground combat rules could have used a few more examples to help eliminate a few ambiguities. One problem inherent with large rulebooks is the difficulty in learning to play the game. Frequently you must interrupt the actual play to look up a rule. This was particularly frustrating in the case of this wargame because different topics were referenced in several different portions of the rulebook. This usually meant reading several different paragraphs of material before finding the one reference I was looking for. It is my assessment that using this wargame in an educational environment would require at least one "expert" in the game rules and mechanics be available to help answer questions, otherwise the players could spend an excessive amount of time looking up rules. It is probably possible to teach a group of players enough about the wargame in a four hour time period to allow them to play if this "expert" is available. Without an "expert" it would probably take the better part of a week for the players to reach a competent level of understanding.

Each gameturn contains several phases of play. One side will be designated as the side with the initiative. In the first movement phase, that side gets to move any front-line ground troops and as many aircraft as desired. The number of naval units that can be moved is determined by the roll of a ten sided dice divided by two, fractions rounded down (thus anywhere from 0 to 5 naval units may move in any one phase). It is even possible that no naval units will be allowed to move during an entire turn. In other words, the U.S. Navy will do absolutely nothing for a 48 hour period of time! The non-initiative side may move any ground units assigned to reserve status, any number of aircraft, and the number of naval units determined by the roll of the die as outlined above. Aircraft and naval units can move while the opposing player is moving. To do so, these units announce they are attempting to intercept the opposing naval or aircraft unit(s), and then as long as those enemy units are detected (more on detection later), the interception procedure

begins. This procedure allows each side alternating movement until the enemy player accomplishes the desired mission or the interception occurs. Following the results of the interception combat, any remaining enemy attackers may continue their specified mission(s) and the defender can attempt another interception with any unused units still available.

During the second movement phase, only ground units in a reserve role for either side may move, providing they did not move in the previous phase. Naval and aircraft units are allowed the same movement options as above, although a new naval dice roll is made for each side. Any naval unit that already moved in the previous movement phase may not move again. The third phase is identical, except the non-initiative player gets to move front-line units while the initiative player may only move reserve ground units.

Playing time can range from a few hours to several days, depending on the number of players, the scenario chosen, and the number of turns you decide to play. One of the positive features of this wargame is its suitability for play by several people. The map is large enough to allow up to six or eight players to fit comfortably around it, and the various types of forces and nationalities available make a division of responsibilities rather logical. For example, if playing Desert Shield, one player could handle the Iraqi air force, another the ground troops, and a third the logistics. Similarly for the coalition, one player could handle the U.S. Air Force, while others handle the Navy, ground forces, logistics issues, and the coalition forces. This was one of the few wargames that was easily adaptable to group play. In fact, due to the large number of units, several players would likely speed up play.

5.5.1 Aerospace Control. Aerospace control - I. The battle for aerospace control is definitely addressed in this wargame. Any aircraft with an air-to-air rating is allowed to conduct interception missions against incoming enemy aircraft, provided it has not already performed another air mission during the current phase. Aircraft

carriers can place interceptors on combat air patrol which is a modified form of interception, or simply conduct a normal interception mission. Iran, Iraq, the Soviets and the U.S. all have Early Warning and Detection Aircraft (EWDA) available to aid in the interception process. *Gulf Strike* also allows strike missions against enemy air units and airbases.

If you read the rules literally, airbases are listed as support units. The rules stipulate that no support unit may be attacked until all combat units in that hex have received the maximum number of hits allowed due to air attack. This is a major flaw with the wargame because it allows you to place a combat division in any hex with the airbase. Before the air base can be attacked, that combat division will have to suffer eight hits from aircraft. Only three aircraft units at a time may participate in any one attack. If a player desires to send fighter escorts with the bombers, then you are limited to either one fighter and two bombers, or two fighters and one bomber. The maximum number of hits an individual aircraft unit may ever inflict on a ground unit is two. Two hits are only attained if the die roll is four or more less than the aircrafts modified bombardment rating. Many aircraft have bombardment ratings of four or less to begin with, so these aircraft are incapable of attaining more than one hit. Even A-10 units have a bombardment rating of only 7, meaning that only 30% of the time will they attain two hits. The permutations possible to achieve those eight required hits are far too numerous to mention, but the bottom line is anywhere from two to an infinite number of strike packages are required to inflict this amount of damage (an average of eight were required in my playing of the wargame, but my strike packages usually contained one fighter escort). The U.S. player has over fifty aircraft counters available, so assembling eight strike packages during one turn is not difficult. Each aircraft unit that attacks is subjected to large amounts of anti-aircraft fire which results in an attrition level that makes attacking airbases an almost fruitless endeavor. This problem can be easily overcome by simply allowing aircraft to attack bases regardless of other units in the hex, which

is a much better reflection of reality, and probably what the author intended in the first place.

Even with the above modification, attacking an airbase can still prove to be a costly endeavor. One way to "game" the system is to use cruise missiles. The wargame provides a number of U.S. naval units with extremely lethal cruise missile capability, including the three U.S. aircraft carrier battle groups. In playing the Desert Shield scenario, I was able to totally destroy four of the six Iraqi airbases in one turn with navy cruise missiles (an airbase can only suffer three hits before it is destroyed), thus effectively grounding the majority of the Iraqi Air Force. In reality, cruise missiles would probably not be used against airbases due to the nature of the target. As a general rule, cruise missiles are not the most efficient weapon to use against runways or individual hardened aircraft shelters. It is highly unlikely that they could eliminate an airbase. The actual tactics used in Desert Storm involved cutting the runways with specially designed bombs like the Durandal penetrating bomb to ground the Iraqi Air Force, and then methodically beginning the destruction of the hardened aircraft shelters with smart bombs.

The wargame also allows U.S. aircraft to perform up to three missions in the course of one complete gameturn. The Soviets can perform two, and all other countries can perform one. All combat except ground-vs-ground is resolved using a very simple combat results table. The attacker rolls one ten sided die and compares the number rolled with the individual attack value of the attacking unit. The difference determines the index number to check on the Air/Naval Combat Resolution Track. The defender then rolls the die and compares the result to the defending units ECM rating to determine how much that index number is reduced prior to combat resolution. The modified index number is then cross indexed with the table and the actual damage inflicted is determined. Once an air or naval unit has received a number of hits equal to its hit capacity, that unit is destroyed and removed permanently from play. Units that are not completely eliminated may be withheld from future combat

for repairs. Air units can be repaired at any supplied airbase, but only one damage point can be repaired per airbase per turn. Naval units must return to a friendly port in order to repair damage. As an example of the combat process just explained, assume an Iraqi MiG-23 encounters a U.S. Navy F-14 on an offensive sweep. The two counters are displayed in Figure 5.7. Assuming both aircraft have detected each

Iraqi MiG-23			Navy F-14		
Bombardment Rating	4	5	ECM Rating	4	6
Anti-Air Rating	6	●	Sub-Surface Rating	9	●
Anti-Ship Missile Rating	●	4	Hit Capacity	●	5
Movement Point Allowance			Movement Point Allowance		

Figure 5.7. Iraqi MiG-23 versus Navy F-14

other prior to entering the hex, combat will be simultaneous. The MiG-23 with an AA value of 6, rolls a 5. The index number is therefore set to one. The F-14 with an ECM rating of 6, rolls a 4, reducing the index number below zero with a net result of no damage. The F-14 with an AA rating of 9, rolls a 3, setting the index number to 6. The MiG-23 with an ECM rating of 5, rolls a 5, meaning no change to the index rating of 6. A 6 on the Air/Naval Combat Resolution Track equates to 4 hits, which equals the MiG-23s hit capacity, so the MiG-23 is destroyed.

Overall, the wargame attempts to simulate all of the different types of missions that make up the battle for air superiority. One significant limitation is that no more than three aircraft units may make up any one strike. Additionally, all three must originate from the same airbase. This is a bit unrealistic, because in this wargame, in order to send escort fighters with any bomber strike, they all must begin at the same airbase. Doctrine dictates shorter range aircraft be placed at the bases closest to the front, with longer range aircraft at the more distant bases. The wargames

limitations make it impossible for shorter range fighters to accompany longer range bombers.

Since only three attacking aircraft are allowed to be airborne at one time, it is impossible to saturate the defenses directly. In other words, a common tactic to defeat an enemy air force is to send several different strike packages in simultaneously. The lead aircraft include jammers, defense suppression, and air superiority fighters. Following close behind these aircraft would be the actual strike aircraft. This coordinated package will hopefully keep enemy aircraft away from the strikers, suppress the ground defenses, and thus allow the attacking aircraft to successfully reach and bomb their targets. *Gulf Strike* does not allow this. It is possible to send in multiple three ship formations which will hopefully cause the enemy to use up his/her interceptors, but there is no way to suppress the ground fire. Every three-ship formation that over-flies any enemy unit is subject to anti-aircraft fire. This has the effect of increasing the casualties of the attacking force to higher levels than one would realistically expect.

This wargame gets high marks for attempting to account for all the factors that go into the struggle for air superiority, unfortunately the simplifications that make the air system playable abstract several important issues in air planning that lead to the rating of I.

5.5.2 Strategic Attacks. This wargame does provide a very limited coverage of strategic attacks - R. Strategic attacks can occur in the Desert Shield scenario, or Scenario 6 (the oil war scenario) from the second edition. Desert Shield supplies a chemical weapons factory and a nuclear weapons facility in Iraq. These two counters are both located within three hexes of Baghdad and must be destroyed in order for the coalition forces to win. They can be destroyed by suffering five hits from an aerial bombardment. Any damage suffered in one attack can never be repaired, so it is really quite easy to destroy these two targets with either bomber aircraft

or navy cruise missiles. The destruction of the targets has no other effect on the outcome of the game other than preventing coalition victory if they are not destroyed. Once again, the Air Campaign map printed in the article *Desert Storm Mother of All Battles* indicates 8 separate chemical/nuclear/biological warfare facilities[12:16]. Once again, it would appear additional facilities should be added to the Iraqi order of battle.

Scenario 6 identifies several oil terminals (depicted as oil derricks on the map-sheets) as key loading points. Either side may attempt to eliminate these terminals using standard bombardment procedures. Five hits will destroy these oil terminals. Ports and Cities can also be attacked, but this really has no impact on the game unless you are using the political rules. The political rules essentially penalize the use of chemical or nuclear weapons (which are also included in the rules). The political rules are used by the author to determine who wins or loses each scenario. To be quite frank, some of these rules are simplistic at best, but they make the game more exciting. For education purposes, they are very easy to ignore since the goal of education is really to teach the lessons and processes, not to see who wins or loses the battle. No other strategic warfare is modeled.

5.5.3 Interdiction. Interdiction missions, as defined by this wargame, are directed only at hexes on the mapboard. A successful attack increases the movement cost of entering that hex by two, but the first ground unit that enters the hex removes the interdiction marker! An interdicted hex can also serve to limit the ability of any unit to retreat through that hex. The main way interdiction can be used in the game is to affect supply. Every unit must be within 20 armor movement point of a supply source, or a supply depot (represented by depot markers). If the enemy is careless enough to have a unit 19 or 20 movement points away from the nearest supply source, an interdiction attack could place that unit out of supply for the turn. The effects of interdiction are really quite easy to avoid by simply creating supply depots at closer intervals, and as such, interdiction of supply plays a pretty minor

role unless the opposing player has not made any efforts to create a redundant supply network, which again is quite easy to do.

Interdiction also involves attacks on ground troops. This wargame does provide an easy, basic system to allow aircraft to attack ground units. Even though the wargame does not refer to them as interdiction attacks, the players have the option of attempting to bomb any enemy unit they desire. A ground unit can not be totally destroyed by air attacks alone (exception - trucks), they require an enemy ground unit to deliver the final hit. Ground units can absorb varying numbers of combat hits depending on their nationality and size, ranging from three to nine. Each strike package that enters the target unit's hex must first undergo anti-aircraft fire. Any aircraft that suffers a hit aborts its attack and returns to base. If three aircraft are coming in to attack, and the anti-aircraft fire achieves three hits, the rules stipulate that each attacking aircraft must absorb one of the hits before any aircraft can take a second hit. Thus, all three aircraft would abort this attack and suffer one hit. Another strike package could be sent in immediately to attack the same target, but the ground unit(s) would again have the opportunity to shoot. This illustrates how in the process of bombing ground units, aircraft casualties tend to get much higher than they should - I.

5.5.4 Close Air Support. Close air support is represented as a modification to the Ground Combat Resolution Table. This table is based upon attacker-to-defender odds ratios, with a few smaller increments included for battles above of below 1-1 by only one or two factors. To conduct close air support, the player merely has to fly a strike mission against one of the hexes containing attacking units (for defensive) or defending units (for offensive). If the strike successfully avoids interception and anti-aircraft fire and achieves a hit, then the mission is considered a success. For defensive, the effect is a two column shift in favor of the defender on the Ground Combat Resolution Table. The effect for offensive is an addition of two to the die roll for the attacker. (This wargame utilizes a Ground Combat Results

Table where the higher the die roll, the better the result for the attacker). Thus, close air support can influence the outcome of a ground battle, but the players do not necessarily get a feel for the exact influence it has, therefore I rate this MOE an I.

5.5.5 Airlift. Air transport of supplies and troops is modeled. Each scenario contains some air transport capability. The U.S. and the Soviets have a strategic airlift capability in the 1983 and 1988 editions which can bring supplies and light ground units (no tanks) into the region. In the 1990 edition, the author has provided an entire transport system (including ships) to replicate the process of moving the coalition forces into the region. This includes airlift capacity of one brigade per turn, but prohibits these air units from carrying supplies. These strategic airlifters are abstracted, but they do at least succeed in providing a feel for the difficulty in moving a large force over great distances.

On a tactical level, Iran, Iraq, the Soviets and the U.S. all have varying capabilities ranging from helicopters to C-130s. These units can carry light units between friendly bases, or insert them behind enemy lines. They can also move supplies and other support units about the battlefield. Transport can be intercepted, so in order to conduct a mission behind enemy lines, you either have to begin the mission from a base which also has fighters to act as escorts, or have total air superiority. This wargame does about the best job of handling airlift of any commercial wargame I have seen and is rated an S.

5.5.6 Air Refueling. Air refueling is not modeled directly, however the wargame provides the following optional rule:

Soviet and US air units (only) - including helicopters - that are assigned to an airbase may have their regular non-Ferry Movement Point Allowance doubled when performing all non-Ferry missions by expending twice the normal mission Supply Point cost; thus, for example, a Strike mission would cost 4 Supply points. US CV and CVN naval units can

double the Movement Point Allowance of one air unit per Action Stage (no Supply Point cost)[16:41].

This greatly increases the options open to the air units, but it does not address any of the complicating issues involved in the coordination of aerial refueling, therefore it is rated an R.

5.5.7 Electronic Warfare. The wargame attempts to address electronic warfare. Every ship and aircraft has an ECM rating which can be used to reduce the effects of fire against it. For aircraft, the best ECM value in the hex is the one that is used. This allows you to place an EF-111 unit or E-6 unit into any strike package. These units have no combat capability other than their ECM ability. They do provide a better measure of defense for the strike package against any attacks, but the ECM ratings have no impact on the enemies ability to detect them. Another drawback is the E-6s can only accompany aircraft from the carrier they are based upon. Likewise, the single EF-111 is the only jammer aircraft in the U.S. inventory, therefore only one U.S. airstrike per turn can be accompanied by jammers, and then the entire squadron is forced to fly that single mission. The wargame gets an I because it attempted to model ECM, unfortunately it is not realistic.

5.5.8 Surveillance And Reconnaissance. The manner in which Surveillance and reconnaissance is addressed has some good points and some bad points. Essentially, all ground units are in full view at all times. In the Desert Shield scenario, the rules stipulate that the Iraqi player may not examine any units beneath the top unit counter to simulate the lack of intelligence available to the Iraqis historically. Any naval unit which begins a turn "in port" is automatically detected and remains that way for the duration of the scenario. Any naval unit at sea which is detected in the course of play remains detected for the remainder of the scenario. This includes submarines, however there is an optional rule to allow them to regain concealment if they move completely out of the detection range of all enemy units. U.S. Navy

submariners would probably find this rule rather insulting. Aircraft are undetected at the moment they "take off" to begin any mission, but once detected, they remain that way until they land or are shot down.

Iraq, Saudi Arabia, Iran, the Soviets and the U.S. all have various types of Early Warning and Detection Aircraft (EWDA), each with its own independent ability to detect both air and surface naval units (see figure 5.8). These units are positioned during the initial portion of each game turn and remain in that hex until they are either forced to leave by enemy fighters or the end of the turn. EWDA aircraft can not be shot down. If enemy fighters enter their hex, they are removed from the mapboard for the remainder of that gameturn, but return during the subsequent gameturn with no degrade in capability. U.S. and Saudi Arabian AWACS units have a detection range of 21 operational hexes against both naval and air units (21 times 28 km = 588 km), by far the best in the game. Soviet/Iraqi Tu-126s have a naval detection range of 14 operational hexes and an aerial detection range of only 8 operational hexes. The detection values are much lower as well. The numbers which appear in Figure 5.7 represent the value you must roll equal to or less than on a ten-sided die to detect the target. For example, A U.S. AWACS would successfully detect an enemy aircraft unit at a range of 14 hexes on a die roll of 7 or less. The superiority of the U.S. AWACS gives them an impressive advantage in the ability to detect enemy air attacks, and consequently gives the U.S. a huge advantage in the ability to intercept. Surveillance and reconnaissance rates are 1.

5.5.9 Base Operability And Defense. Base operability and defense is only modeled in the sense that the player is allowed to choose what airfields you wish to deploy your airbases on. Base defense involves the interception process described above, as well as the ability to position anti-aircraft units, or any other ground unit with an anti-aircraft capability in the hex - I.

Strategic Hex Range	0					1										2						
Operational Hex Range	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
EWDA AIR Units																						
AWACS Surface	9	9	9	9	9	9	8	8	8	8	8	8	8	8	8	8	7	7	7	6	6	6
Air	9	9	9	9	9	9	8	8	8	7	7	7	7	7	7	7	6	6	6	5	5	5
F-2 Surface	9	9	9	9	9	9	8	8	8	8	8	8	8	8	8	8	7	7	6			
Air	9	9	9	9	9	9	8	8	8	7	7	7	7	7	6	6	6	5	5	4		
Tu-126 Surface	7	7	5	6	5	5	4	4	3	3	2	2	1	1	1							
Air	8	7	7	6	5	4	3	2	1													

Figure 5.8. Partial *Gulf Strike* EWDA Detection Table

5.5.10 Logistics And Combat Support. This wargame combines logistics and combat support into one and calls it supply. Supply plays a very important role in this wargame because no ground or air unit may launch any type of attack (including interception missions for aircraft) without supply points available. Each country is assigned an initial supply level and a re-supply rate (the number of additional supply points which are added to the supply level per turn). Total available supply is tracked for each country on a large chart on the bottom portion of the strategic mapboard. The cost in supply points for an individual ground combat depends on the size of the attacking units as well as the formation they are in (the Formations Effects Table contains all this information). For aircraft units, bombardment attacks (any attack which utilizes the aircrafts bombardment rating) cost two supply points per aircraft counter. Every other aircraft mission costs one supply point per aircraft. Naval units do not use any supply points.

Simply having the supply points available is not sufficient to allow an attack or other air mission. The ground unit, or airbase where the aircraft are based must

be in supply as described in a previous paragraph. Airbases out of supply may not launch any air missions or repair damage. Additionally, one aircraft unit on that base will suffer one hit at the conclusion of each turn in which the airbase is out of supply. Ground units without supply may not attack and also suffer a hit at the conclusion of the turn.

Although supply plays an important role in this wargame, it is abstracted to such a degree that it does not address the issues which concern an air staff. One of the major problems which actually existed during Desert Shield and Desert Storm was deciding not only what logistics and combat support would be needed, but also deciding in what order it should be delivered. In this wargame, all supply points represent the same generic value. If the U.S. player performs 100 interception missions during a game turn, then the 100 supply points spent represent the fuel and air-to-air munitions needed. Conversely, if those same aircraft units fly 50 ground attack missions, then those 100 supply points represent the fuel, bombs, and other ammunition expended. Or, those 100 supply points could be used to conduct a rather large ground offensive. While the wargame demonstrates the need to have adequate supplies available prior to beginning any large offensive, it does not address the quite distinct differences between the types of supplies that are required.

One additional flaw in the supply logic of this wargame involves the U.S. aircraft carriers. These units do not expend any supply points from the U.S. supply pool for any of their attacks. Thus, the USS Enterprise (which carries 2 F-14, 2 F-18, 1 A-6, 1 E-6, 1 S-3, and 1 SH-3 helicopter), can perform 24 individual air missions each turn (each aircraft unit could fly 3 times in a turn). If the F-14s perform CAP, the S-3 and SH-3 perform ASM missions, and the rest perform strike missions with the E-6 jamming, that amounts to the equivalent of 33 supply points per turn. Take that times 3 to account for the other two carriers and you have a supply consumption rate of 99 supply points per turn. Not bad when you consider that the entire country of Iraq can only produce 30 supply points per turn, Saudi Arabia 20, Oman

10, UAE 10, Bahrain 5, and Qatar 5. In other words, the three Navy carriers have more inherent supply capacity per turn than Iraq and the entire coalition countries combined! Even the U.S. ground and air forces are limited to a maximum of 36 supply points that can be brought into theater every **other** turn. The game allows the carriers to operate every available air unit at maximum capacity for an unlimited amount of time! Even if we assume that the aircraft carrier counter represents not only the carrier battle group, but replenishment ships as well, there is simply no way the carriers have that type of combat capacity. Logistics receives an I while combat support receives an N.

5.5.11 *Weather.* Weather is not modeled - N.

5.5.12 *Day/Night.* Day/night battles are not modeled - N.

Gulf Strike was by far the most suitable wargame I analyzed. It does not provide an accurate enough simulation of the major combat roles and missions of air power. The wargame impressed me with the amount of combat processes it addressed, and in many cases, the simple playability. With a number of modifications, it is my opinion that this wargame could be utilized to provide familiarity with the roles and missions of aerospace power to inexperienced personnel, much like the navy did for that group of new analysts (see chapter 2). It might also be ideal in an academic environment as an illustration of the roles and missions of aerospace power for ROTC or Air Force Academy cadets. The wargame is not appropriate for teaching the employment of the roles and missions of aerospace power to experienced Air Force officers whom one would expect to find comprising an air staff.

Some of the modifications needed include:

- better supply transport rates
- limitations on aircraft carrier operations
- limitations on cruise missile employment

- larger aircraft strike packages
- more accurate orders of battle
- better rules to deal with Scuds
- more accurate combat values for unit counters
- better detection rules for ships
- more strategic warfare targets
- inclusion of weather
- inclusion of day/night
- separation of types of logistics
- inclusion of combat support
- a better representation of the intelligence gathering process

5.6 Conclusion

Although each of the four wargames have some good points, they all fail to address various roles and missions of aerospace power. Each wargame seems to address some of the roles and missions quite well, and other roles and missions very poorly. Taking the various portions that each wargame does well would provide a good starting point for any modeler who was trying to design a wargame illustrating the proper employment of aerospace power. The bottom line is that none of these wargames adequately address the roles and missions of aerospace power.

Aerospace Control	I
Strategic Attacks	R
Interdiction	I
Close Air Support	I
Airlift	S
Air Refueling	R
Electronic Warfare	I
Surveillance and Reconnaissance	I
Base Operability and Defense	I
Logistics	I
Combat Support	N
Weather	N
Day/Night	N

KEY

N = Not Modeled

S = Satisfactory Model

R = Rudimentary Simulation

I = Incorrect or Inaccurate Simulation

Figure 5.9. MOE Summary for *Gulf Strike*

VI. Conclusions

6.1 Introduction

Despite the plethora of commercial wargames currently available, no wargames were discovered that are suitable for use at the Air Force Wargaming Center. This in no way implies that commercial wargames do not have merit, or that there is no place for them within the Department of Defense. Rather, it points out that as of the writing of this paper, the commercial wargaming sector simply has not addressed the roles and missions of aerospace power in a manner to provide worthwhile education to senior military leaders. This is due partly to the complexity required to simulate air power applications, partly the current types of wargames that sell well in the commercial market, and partly the abstraction of air power to an unusable level. It might appear that another disadvantage would be the lack of inclusion of classified information regarding the performance capabilities of modern weapons. While classified information might provide some measure of increased understanding of current capabilities, it is not necessary to provide a good, usable, educational wargame.

6.2 Summary

A large number of commercial wargames address tactical, plane-vs-plane engagements. Many of these are regarded by the commercial wargaming industry as excellent simulations of aerial combat, but the focus of these games is not sufficient to teach senior military leaders the application of aerospace power. As I mentioned earlier, the Air Force Wargaming Center is concerned with the decision making process to best prosecute the entire air war. They are not interested in the individual tactics of one or two aircraft. This makes the tactical level commercial wargames unsuitable, therefore it simply does not matter how accurate these games are since they can not be used to explore the options faced in a theater level war.

As a general rule, the larger scale, theater level and strategic level commercial wargames, include some measure of air power. Most of these focus mainly on the ground portion of the war, with air and naval forces acting in a subservient manner. This creates a level of abstraction in the simulation of the roles and missions of aerospace power that make the wargames totally unsuitable. The few wargames that make a significant attempt to model aerospace power are all among the most complex commercial wargames currently available, with extensive rules and very large numbers of unit counters. This complexity level makes the games difficult to learn and the large number of unit counters require an excessive amount of time to set-up, and a comparatively lengthy time to move each gameturn. Additionally, in most cases that single gameturn represents one week of real time, as a minimum, all the way to three months. These long time periods are satisfactory to provide an aggregated feel for the effects of the missions chosen for that particular gameturn, but they also make it difficult to trace exactly what the key factors were that lead to the success or failure of a given mission.

Many of the computer wargames available focus more on arcade type processes. The graphics and style of play are more important than the combat processes. In other words, the target market is the person who wants to actually fly the plane or drive the tank, see a target, shoot it, and watch it blow up. These wargames have many bells and whistles designed to allow the player to feel like they are actually there, but as far as providing education value in the application of aerospace power, these wargames completely miss the mark.

According to Dunnigan, the number one demand in the commercial board wargame market is for ground combat wargames, especially tank battles. Naval warfare is a distant second, and air warfare is ranked somewhere below that. Since air warfare ranks so low on the demand spectrum, there are proportionally fewer air board wargames available. Nearly all of these focus on the tactical level. In addition, compared to famous land and naval battles, very few famous air battles

have occurred. Most air battles have been rather short term affairs (the Battle of Britain, the U.S. daylight precision bombing campaign against Germany, and the Linebacker offensives against Vietnam are a few exceptions). Other air battles, like the strategic bombing and interdiction campaigns against North Korea were not really battles since the North Koreans really had no way to fight back. This lack of famous air battles is one of the reason so few air wargames exist on other than a tactical level. Remember, Dunnigan said that one of the main reasons people play wargames is "to experience history". If there are only a few historical battles, then it is difficult to have large numbers of games.

Finally there is the issue of classified information. Much of the information about the performance of modern weapon systems is highly classified, and therefore unavailable to the commercial wargame industry. For this reason, many of the combat results processes in commercial wargames are based on unclassified information which does not always reflect the true abilities of the weapon system in question. The wargame's author must make assumptions about the capabilities and this can lead to unit counters with too much combat power or not enough. This is not a serious limitation, especially in aggregated models since they are only capable of providing general trends, not specific information. In other words, if one aircraft is better than another, it may not matter that the exact combat values are incorrect, as long as the wargame provides information of a relative nature.

Commercial wargames can be very good at teaching some of the lessons of history. A good commercial wargame can provide a sense of important factors like the terrain of the battlefield (which can provide insight as to why a battle occurred there, or why an outnumbered defender was able to defeat the superior enemy) or the quality of opposing forces, both equipment and training.

This thesis has not changed my overall opinion of commercial wargames. Wargaming remains my favorite hobby, although I have a new appreciation for computer wargames. I am not convinced that commercial wargames might not have a poten-

tial training function in other areas of the Department of Defense, but that goes beyond the scope of this thesis. I am convinced that no commercial wargame currently exists that adequately addresses the roles and missions of aerospace power, nor can any of the existing wargames be **easily modified**. The Air Force Wargaming Center already has wargames and experienced personnel that simulate air staff operations in a more appropriate manner. Additionally, the extra effort required for board wargames makes them significantly less desirable for use in educating senior military leaders due to the extensive amount of time required to move the counters and resolve combat. That is why computerizing as much of the process as possible is such an important factor. Current commercial computer wargames have not achieved the sophistication level needed, nor do they offer the multi-player capability desired.

One final consideration has to do with the primary concern of the commercial wargaming market - profit. If a commercial wargame does not sell, it does not last very long. This concern causes commercial wargamers to concentrate on the "exciting" aspects of combat, while ignoring or simplifying the "boring" ones (like logistics issues). The main concern for a military wargame is realism (including logistics) and not how "exciting" it is. War is not fun. It requires a great deal of complex actions, such as staff coordination, command decisions, intelligence gathering and assessment (and countless other activities) to plan and conduct a successful campaign where the consequences of these actions could be the difference between life and death. This fundamental difference in the perception of what is important in a wargame has created a barrier between the commercial wargames and the military wargames. Until a commercial wargame is designed which focuses on the realistic portrayal of the roles and missions of aerospace power, without worrying about profit, it is my opinion that the Air Force Wargaming Center's wargames will remain, by far, a better alternative than existing commercial wargames for the education of senior military leaders.

Bibliography

1. Berg, Richard H. et al. *Wargame Design The History, Production, and Use of Conflict Simulation Games*. New York: Simulations Publications, Inc., 1977.
2. Boylan, Kevin M. "Flashpoint: Golan, Developer's Notes and Errata," *Avalon Hill General*, Volume 28, Number 1, 31-34 (1992).
3. Department of the Army. *Engineering Design Handbook*. DARCOM-P 706-101. Washington, D.C., November 1977.
4. Department of Defense. *Dictionary of Military and Associated Terms*. JCS Pub 1. Washington, D.C., 1 June 1987.
5. Department of the Air Force *Air Force Manual 1-1, Volume I*. Mar 92.
6. Department of the Air Force *Air Force Manual 1-1, Volume II*. Mar 92.
7. Dunnigan, James F. *The Complete Wargames Handbook, Revised Edition*. New York: Quill William Morrow, 1992.
8. Dunnigan, James F. *The Complete Wargames Handbook*. New York: William Morrow and Company, Inc., 1980.
9. Dupuy, Col. Trevor N. *Future Wars*. New York: Warner Books Inc., 1993.
10. Editors of Consumer Guide with Jon Freeman. *The Complete Book of Wargames*. New York: Simon and Schuster, 1980.
11. Edwards, John. Rules for playing *The Russian Campaign*, Second Edition. Supplemental to *The Russian Campaign* wargame by The Avalon Hill Game Co., 1977.
12. Eldridge, Bo. "Desert Storm Mother of All Battles," *Command Magazine*, Issue 13/ Nov-Dec, 12-43 (1991).
13. Fernan, Capt Jude C.. *Gettysburg: An Analysis of the Training Value of Commercial Combat Models*. MS thesis. AFIT/GST/ENS/92M-02. School of Engineering, Air Force Institute of Technology(AU), Wright-Patterson AFB OH, Mar 1992 (AD-A248156).
14. Hartman, James K. *Lecture Notes in High Resolution Combat Modelling*. James K. Hartman, 1985.
15. Hartman, James K. *Lecture Notes in Aggregate Combat Modelling*. James K. Hartman, 1985.
16. Herman, Mark. Rules for Playing *Gulf Strike*, Third Edition. Supplemental to *Gulf Strike* wargame by Victory Games, 1990.
17. Jackson, Robert. *Air War over Korea*. New York: Charles Scribner's Sons, 1973.
18. Koger, Norm. Rules for playing *Conflict: Korea*. Supplemental to *Conflict: Korea* computer wargame by Strategic Simulations, Inc., 1992.

19. —. Rules for playing *Conflict: Middle East*. Supplemental to *Conflict: Middle East* computer wargame by Strategic Simulations. Inc., 1991.
20. Lester, David, et al. Rules for playing *Air Force Commander*. Supplemental to *Air Force Commander* computer wargame by Impressions, 1992.
21. Maxwell, Bruce. *Air & Armor Standard Game Rules*. Supplemental to *Air & Armor* wargame by West End Games, 1986.
22. Negrelli, Major Edward P. Personal conversations, class notes, lectures and handouts. OPER 775/6, Land Combat Modeling I and II. School of Engineering, Air Force Institute of Technology (AU), Wright Patterson AFB, OH, (October 1992 - March 1993).
23. Palmer, Nicholas. *The Best of Board Wargaming*. New York: Hippocrene Books, Inc., 1980.
24. Perla, Peter P. *The Art of Wargaming*. Annapolis: Naval Institute Press, 1990.
25. Readers survey. "1987 F&M Readers Poll," *Fire & Movement*, Volume 56, (1988).
26. Sinigaglio, Bruno Rules for playing *The Battle of the Bulge*, Second Edition. Supplemental to *The Battle of the Bulge* wargame by The Avalon Hill Game Co., 1981.

Vita

Captain Scott Goehring was born on 16 May 1960 in Manitowoc, Wisconsin. He graduated from Hayward High School in Hayward, Wisconsin in 1978. He attended the University of Wisconsin at Superior and received Bachelor of Science degrees in Mathematics and Geography in May, 1982. He was a Distinguished Graduate from the AFROTC program and received his commission in May 1982. After graduation, he was assigned to Grand Forks AFB, ND where he served as a Missile Launch Officer in the Minuteman III weapon system. He served as an instructor, an Emergency War Order Training Officer, and had the distinction of winning the 1987 SAC Missile Combat Competition, earning recognition as the Best Missile Combat Crew Commander in the Strategic Air Command. He completed a Masters degree in Business Administration from the University of North Dakota in July 1987. In 1988 he was assigned to Vandenberg AFB, CA to the TOP HAND program for the purpose of conducting operational test launches of Peacekeeper and Minuteman ICBMs. In August of 1991 he entered the Graduate Strategic and Tactical Operations Research Program, School of Engineering, Air Force Institute of Technology, Wright-Patterson AFB, OH. He is a major-select two years below-the-zone and is currently the 29th ranked wargamer in the Avalon Hill Game Company's world-wide A.R.E.A. rating system.

Permanent address: R.R. 7, Box 7854
Hayward, Wisconsin 54843

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